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# Early-Childhood Computer-based Testing: Effects of a Digital Literacy Intervention on Student Confidence and Performance

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# EARLY-CHILDHOOD COMPUTER-BASED TESTING:

# EFFECTS OF A DIGITAL LITERACY INTERVENTION

# ON STUDENT CONFIDENCE AND PERFORMANCE

By

BENJAMIN-DAVID CHRISTOPHER LEGRAND

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This is to certify that the Doctoral Dissertation of

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has been approved by the examining committee for the dissertation requirement for the Doctoral Program in Education Leadership in the Division of Education and Counseling, May, 2018.

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Abstract

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Chair: Reneé V. Akbar

Early-childhood digital students grow up in a fast-evolving age of technology requiring them to use and create with technologies and demonstrate core content knowledge. Although third grade students are mandated to master a new language of standardized testing, a large percentage must also learn a language of technology to complete new computer-based tests to measure content mastery. Krashen (1982) defines high affective filter as negative emotional/motivational factors interfering with understanding and cognition. This high affective filter reduces confidence and negatively impacts measuring content mastery on new computer-based tests. Two third grade classrooms at a high-poverty metropolitan school participated in a quasi-experimental study to measure the effects of a digital literacy intervention on computer-based testing confidence and student performance in social studies and mathematics. The intervention group participated in a digital literacy intervention developing keyboarding and coding skills. The control group participated in a mock digital intervention. Both participant groups received computer-based pretests and posttests in social studies and mathematics, and both groups completed Technology-Use Baseline and computer-based testing (CBT) confidence surveys after each pretest and posttest. A comparison of means was used to analyze change between pretest and posttest. Regression analysis and ANOVA were used to determine any significant relationships between CBT-Confidence, student performance and digital literacy intervention variables.

The study results found a significant relationship with a change in student performance and computer-based testing confidence in social studies but not mathematics. There was also a direct, positive significant relationship with the coding intervention and change in computer-based testing confidence in social studies but not mathematics. The researcher suggests that mode of technology integration within the two classrooms impacted the research study. The research study suggests that learner-centered technology integration within the social studies classroom positively impacted the research study when comparing the teacher-centered technology integration within the mathematics classroom.

Research study suggests that school leaders consider providing teacher professional development opportunities for learner-centered technology integration (Chow et al., 2012, Considine et al., 2009). Future research could include larger sample population, using the same teacher to teach both subjects, and implementing longitudinal study to track student performance on standardized testing.

*Keywords: technology affective filter, digital divide, information communication technology (ICT), computer-based testing CBT-confidence, student performance, digital literacy intervention, coding, keyboarding, video games*

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## DEDICATION

This dissertation is dedicated to the memory of my beloved mother,

Donna Smith Legrand

who was my inspiration to pursue my doctoral degree.

She remains my guardian angel. This is for her.

This dissertation is also dedicated to my oldest sister Gigi.

Your battle with cancer is a demonstration of resilience and joie de vivre.

We cherish every moment with love, laughter, and life.

And finally, this dissertation is also dedicated to

my family, colleagues, and students (past and present).

Your love and support guided me daily.

Thank You!

#BNA #143

#TeamProdigy

# CHAPTER ONE

# INTRODUCTION

The National Association for the Education of Young Children (NAEYC) and Fred Rogers Center for Early Learning and Children's Media (2012) define the early-childhood spectrum of child development from birth to 8 years old. Students today, who fall in this age range, belong to the "digital native" community of individuals born into a rapidly-evolving technological era (Considine, Horton, & Moorman, 2009; Prensky, 2005). Programme for International Student Assessment (PISA) and National Assessment of Education Progress (NAEP) find that minority students in under resourced communities have significant differences in student performance and demonstrate low academic achievement "by large margins" (Donlevy, 2006; PISA & OECD, 2015, p. 27).

No Child Left Behind Act (NCLB, 2001) and Every Student Succeeds Act (ESSA, 2015) mandate state departments of education to measure school performance scores and annual yearly progress (AYP) goals to evaluate a school's overall student performance (Morgan, 2012). ESSA testing requirements resulted in the development of statewide computer-based testing (CBT) programs for standardized measurement of student performance and achievement in grade-level content areas (Irving, 2006). Early-childhood students start taking these standardized tests for the first time in third grade. As students start taking computer-based tests, they must develop technological competencies to demonstrate mastery of core-content areas of reading, mathematics, science, and social studies (Chang, 2017). Testing anxiety contributes to a high affective filter which Krashen (1982) defines high affective filter as negative emotional/motivational factors interfering with understanding and cognition. Three constructs make up the affective filter and impacts student understanding: self-confidence, motivation, and anxiety. Students with limited technological language competencies have a high affective filter that impedes learning and demonstration of core-content knowledge (Krashen & Tracy, 1982).

The affective filter explains how psychological factors of anxiety, self-confidence, and motivation impact language development, student understanding and performance (Krashen, 1982). Third grade students with limited technology skills taking standardized computer-based tests for the first time exhibit a high affective filter characterized by high anxiety, low self-confidence, and motivation (Ghaderi & Nikou, 2016).

**Statement of the Problem**

As measurement of Common Core State Standards transition to computer-based testing, early-childhood students must develop technological competencies to meet the growing digital learning expectations of the 21st century and be able to effectively demonstrate core content mastery on new computer-based tests (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010a). Unequal distribution of access and digital resources in under resourced, marginalized communities does not provide students living in these communities with the necessary technological language of digital literacy (Gomez, Barron, & Pinkard, 2014; Chang, 2017).

As they take computer-based standardized testing for the first time, disadvantaged third grade students within under resourced communities lack the development of a technological language and struggle to communicate, produce, and design with technology to show core-content competency and do not perform adequately on these new computer-based standardized assessments (Chang, 2017, Diaz, 2008). With Common Core State Standards demanding greater digital literacy competencies, a new digital achievement gap shifts from providing basic computer access to training students to engage in high-level intellectual tasks that use technology (Margolis, Estrella, Goode, Holme, & Nao, 2008).

**Purpose of Study**

The purpose of this research study was to examine the effects of a digital literacy intervention on third grade students in an under resourced community with limited technology use and technology skills, and the relationship between computer-based testing confidence and student performance on social studies and mathematics computer-based tests. Common Core State Standards, as published by National Governors Association Center for Best Practices & Council of Chief State School Officers (2010b), emphasize inquiry-based learning with assessments requiring multiple correct answers, developing timelines, and mathematical formulas as well as utilizing technology skills to demonstrate content mastery. The U.S. Department of Education-Office of Educational Technology (2016) found a growing digital use divide that contributes to a widening achievement gap within high-poverty schools. The National Education Technology Plan indicated a dichotomy between routine high-level technology use and low-level technology use for passive content consumption. Furthermore, the more high-level technology use lead to higher technology competency levels (Gomez et al., 2014, U.S. Department of Education, 2016). The digital literacy intervention should lower the student affective filter by raising technology confidence with routine technology use and technology skills development while increasing student performance on computer-based tests.

**Research Questions and Hypotheses**

The research study investigated the affective filter construct of self-confidence and its relationship with student performance from pre-to-posttests. Of the three affective filter constructs, this research study focused on the confidence construct as a possible predictor of student performance (Alodiedat & Eyadat, 2008). The researcher wanted to investigate a relationship between participant's CBT-confidence and student performance score from pre-to-posttest. Therefore, this overarching research question guided this research study:

Q1. What is the relationship between third grade computer-based testing (CBT) confidence and student performance in social studies and mathematics in both participant groups?

Common Core State Standards require students to use technological skills to demonstrate knowledge of core grade-level content on standardized assessments (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010b). The research study wanted to determine the relationship between CBT-confidence and student performance change from pre-to-posttest. Furthermore, Campbell (2014) suggested that early-childhood classrooms need intentional programming (digital literacy intervention) that incorporates new media to close the achievement gap in marginalized and under resourced communities in most urban and suburban school districts. Based on the overarching research question, the research study proposed the following hypotheses pertaining to computer-based testing (CBT) confidence:

$H_{a1}$ = The intervention group will have significantly higher mean scores in social studies CBT-confidence and social studies performance than the control group.

$H_{b1}$ = The intervention group will have significantly higher mean scores in mathematics CBT-confidence and mathematics performance than the control group.

The null hypotheses:

$H_{a0}$ = There is no significant relationship between social studies CBT-confidence and social studies performance as measured by the mean scores among intervention and control groups

$H_{b0}$ = There is no significant relationship between mathematics CBT-confidence and mathematics performance as measured by the mean scores among intervention and control groups.

Through the digital literacy intervention, the participants should have increased confidence with computers through routine use and technological skills development and thus reduce the affective filter with regards to technology. The total of coding modules (Levels Completed) and total number of lines coded (Lines Coded) served as the only reliable indicators to measure the digital literacy intervention. Therefore, the following secondary research question involving the intervention group also guided this research study:

Q2. What is the relationship between coding levels completed and lines coded on CBT-confidence in social studies and mathematics of the intervention group?

The digital literacy intervention provided opportunities for students in an under resourced school to participate in high-level computer-based experiences (Margolis et al., 2008). The secondary research question included the following hypotheses pertaining to CBT-confidence:

$H_{c1}$ = The mean score of change in social studies CBT-confidence of the intervention group will have a direct (positive) significant relationship with coding levels completed and lines coded.

$H_{d1}$ = The mean score of change in mathematics CBT-confidence of the intervention group will have a direct (positive) significant relationship with coding levels completed and lines coded.

The null hypotheses:

$H_{c0}$ = There are no significant differences between mean score of change in social studies CBT-confidence, coding levels completed, and lines coded of the intervention group.

$H_{d0}$ = There are no significant differences between mean score of change in mathematics CBT-confidence, coding levels completed, and lines coded of the intervention group.

**Significance of Study**

This research study is important to the understanding of how negative emotional and motivation factors relating to technology can interfere with student thinking and ability to demonstrate content mastery. As Delpit (2006) extended Krashen's (1982) affective filter research to minority and high-poverty communities, research implications could further explain the digital divide in terms of a socio-emotional construct called the affective filter. The affective filter concept could also dictate the need for greater high-level technology use and skills development in early-childhood classrooms. Existing technology suggested use policies conflict with each other and result in technology restrictions and inconsistent technology use within classrooms (American Academy of Pediatrics, 2016, NAEYC and Fred Rogers, 2012, Lovely & Moberly, 2012).

This research might also bring greater understanding to the importance of high-level technology use and skills development within early-childhood classrooms in marginalized communities to include use of technologies within the infrastructure and the knowledge and application of technology skills (Ritzhaupt, Liu, Dawson, & Barron, 2013). Furthermore, this research study could suggest a need for alternative means for technology use within under resourced classrooms that provide a simple solution to routine technology use, and greater skills development leading to higher confidence on computer-based testing and accurate demonstration of core-content mastery (Irving, 2006).

**Definitions of Key Terms**

21st century learning skills: Skills and capabilities that students need as communication technologies advance to compete within the global economy. These skills include use of social media and learning networks to create videos and blogs (Gomez et al., 2014).

Achievement gap: Developing societal construct that explains the lack of student performance between affluent and under resourced school groups as it pertains to race and class (Gosine & Islam, 2014).

Affective filter: Krashen (1982) found that affective conditions such as fear, insecurity, and anxiety limit conscious learning and knowledge acquisition. The affective filter occurs when a student lacks motivation, does not identify with the language spoken, or is overanxious about performance. Delpit (2006) explained that the affective filter results in mental blocks which impact knowledge acquisition.

Collaboration: High-level intellectual task that falls within what Jenkins, Clinton, Purushotma, and Weigel (2009) defined as participatory culture which includes managing information and self-guidance of one's own learning, combined with the respectful sharing of knowledge to form a "collective intelligence" (p. xiv). This meaningful interaction requires working through opposing viewpoints to create an outcome.

Confidence: An individual's self-assurance, or self-perception, about in his/her abilities to successfully complete a task. The affective/motivational issues create barriers that limit one's perception of task completion. One's perception can also affect perceived confidence, which may or may not represent the actual outcome (Arnone, Small, & Reynolds, 2010).

Digital divide: The digital divide began as a learning gap in which students did not have computers. Now, it has evolved into students not knowing how to productively use computers. DiMaggio, Hargittai, Celeste, and Schafer (2004) and Hargittai and Hinnant (2008) define the digital divide as, “a multidimensional construct that also captures inequities in use of and expertise in computing tools….The ways technologies are used have been shown to vary by family income, age, ethnicity, gender, education level, and geographic location” (p. 5). The U.S. Department of Education–Office of Educational Technology (2016) evolved the term by separating those using technology to engage in high-level intellectual tasks (e.g. digital collaborations) from those who use technology for passive content consumption.

Digital immigrant: Individuals born before 1983 and today (2018) (Emmanuel, 2013, Gomez et al., 2014, Prensky, 2005). Digital immigrants are those who struggle to learn and apply new information communication technology (ICT) skills due to constant technological evolution with new technology quickly becomes obsolete.

Digital literacy: The State of Louisiana Department of Education (2016) defined digital literacy as “the ability to use technology to find, evaluate, create, and communicate information” (p. 1). Critical thinking is essential to the foundation of digital literacy skills (Jenkins et al., 2009). Scheibe (2004) further defined digital literacy as an incorporation of multiple literacy skills so that the learner can use information communication technology (ICT) to develop a higher conceptual understanding of content and apply learning to relevant tasks beyond the classroom.

Digital native: Individuals born in 1983 and beyond, who are immersed in a digital culture with access to devices and social media platforms (Emmanuel, 2013, Gomez et al., 2014). Digital natives do not know of a world before smartphones, video games, tablets, and social media.

Early-childhood education (ECE): NAEYC (2009) defined the early-childhood spectrum of child development as being from birth to 8 years old.

Economically disadvantaged student: An individual meeting the income eligibility guidelines for free or reduced lunch, which equates to less than or equal to 185% of federal poverty guidelines (State of Louisiana Department of Education, 2015).

Limited technologies competencies: Limited technology competencies stem from having little or no understanding of how to use technology. Perez and Murray (2010) extend that these competencies are taken for granted which result in students lacking sufficient computing and internet (information communication technology) skills.

Marginalized community: Gosine and Islam (2014) defined the marginalized school community as minorities determined to "use schooling to achieve social mobility and give back to the community despite feeling alienated within an educational system that is largely oblivious to their frame of reference and generally fails to recognize the abilities and assets cultivated within their communities" (p. 4).

Millennial: Individuals born between 1983–2001 who have grown up in an environment in which they are constantly exposed to computer-based technology (Emanuel, 2013).

Pair programming (PP): A software development technique or practice that involves two programmers working together at one computer. The "driver" uses the computer to keyboard in the code. The "navigator" observes the driver's work, reviews the keyboarded code, and provides support through pointing out potential errors and offering ideas to problem-solve. The two programmers switch roles frequently (Zhong, Wang, Chen, & Li, 2017).

Passive content consumption: Low-level intellectual tasks that involve surfing the web and performing basic web searches, viewing web videos, sending and receiving text messages, accessing social media sites, and checking and receiving email (U.S. Department of Education–Office of Educational Technology, 2016).

Student performance: Academic development measuring the demonstration of learning of subject content within the classroom through continuous assessment of skills and content mastery (Robinson & Xavier, 2007).

Student achievement: Through routine assessment of student performance, student achievement is a single-point, often yearly, assessment of student's performance measured by state standardized test (e.g. LEAP 2025) (Robinson & Xavier, 2007). Student achievement is often linked to teacher and school accountability measures set forth by No Child Left Behind Act (NCLB, 2001) and Every Student Succeeds Act (ESSA, 2015).

**Overview of Methodology**

This six-week, quasi-experimental, quantitative study involved administering computer-based pretests and posttests in social studies and mathematics to an intervention and control group of 3rd graders participants. Participants also completed computer-based testing confidence (CBT-confidence) via online survey. The intervention group received a digital literacy intervention that involved keyboarding and coding modules that culminated with the development of a video game segment. The control group received a mock digital intervention that involved digital access of digital *Scholastic News – Grade 3* magazines. The computer-based pretests and posttests in social studies and mathematics were compared with participant self-reported CBT-confidence scores. As part of the interventions, both groups completed the same computer-based posttest and CBT-confidence surveys. Correlation and regression analyses were completed to evaluate the effects of the interventions on student performance and CBT-confidence in third grade social studies and mathematics.

**Delimitations and Assumptions**

The researcher chose this course of study to understand the relationship between CBT-confidence level and student performance in third grade social studies and mathematics. As third grade students begin taking standardized tests, these early-childhood digital natives must have technological competencies to complete new computer-based testing (CBT) with the modernization of standardized testing (U.S. Department of Education–Office of Educational Technology, 2016). Sociocultural and constructivist theories suggest the importance of socialization and language development to reduce the affective filter that impedes knowledge acquisition (Krashen, 1982, Delpit, 2006).

Krashen (1982) defined the affective filter as complex negative emotional factors comprised of three constructs (anxiety, motivation and self-confidence) that affect cognitive reception and processing. This particular research study focuses on the confidence construct because researchers have consistently studied confidence as a predictor of student performance (Alodiedat & Eyadat, 2008). Harrison and Rainer (1992) concluded students avoid technology due to their low confidence.

This research study developed a theoretical framework that applied the affective filter theory set forth by Krashen (1982) and Delpit (2006) to the existing information communication technology digital divide framework established by Hohlfield, Ritzhaupt, Barron and Kemker

(2008).  This theoretical framework suggests that the development of technology skills may impact confidence of early childhood student performance on computer-based testing (CBT) for the first time.

The digital literacy intervention has three components of technology skills development aligned to the theoretical framework: keyboarding, coding, and game creation.  The research study focuses on coding elements measuring the number of lines coded [LinesCoded] and number of completed levels [CompletedLevels] because these intervention variables were the only valid and reliable measurements of the digital literacy intervention.

**Organization of Document**

This research study includes five chapters.  The first chapter provides an introduction and overview of research questions and hypotheses.  Chapter two provides a synthesis of literature discussing the impacts of early childhood pedagogies; digital divide; achievement gap; information communication technology (ICT) framework; and affective filter on technology competencies.  The third chapter outlines the research design and methods to assess the interventions.  The fourth chapter reports the research findings with relevant statistical analysis reports.  The final chapter provides a discussion of results and analysis of findings with implications and recommendations for future research.

# CHAPTER TWO

## REVIEW OF LITERATURE

The literature review serves as a synthesis of standard classroom learning pedagogies of constructivism, collaboration, and shared learning within a typical ECE social classroom. Although swift technological advancements have sparked new trends in the field of information communication technology (ICT), the digital divide has evolved from a term of mere access to a combination of access, usage and skill (Ritzhaupt et al., 2013). Most research on the digital divide comes from middle to high school preparation for higher education. As global competition increases, Common Core State Standards have integrated ICT competencies within the new computer-based standardized tests. In a study relating technology skills and relationship to technology, Emanuel (2013) found that most digital natives knew how to use technology, but not how to create it or navigate it for computer-based testing. Common Core State Standards have incorporated technology use within content standards and standardized tests; therefore, early-childhood digital natives must develop the necessary technology skills to complete these new computer-based assessments.

While computer access was thought to bridge the achievement gap and curtail the digital divide, swift technological advances with newer mobile devices have affected teaching and learning as well as assessment in modern classrooms. Grantham (2002) suggested the obvious movement from lecture and passive technology use within classrooms to using technology for more interactive modes of classroom learning. However, in their policy guidelines, the American Academy of Pediatrics (2016) suggested limiting the use of media and technology within ECE classrooms. Consequently, digital immigrant educators and school leaders implement this policy which, in turn, limit the use of technology within the ECE classroom and potentially impact the teaching and learning of early-childhood digital natives.

The shift to computer-based testing that requires essential technological skills to demonstrate core content mastery, the digital achievement gap widened in marginalized, under-resourced communities as the digital divide shifted from technology access to technology use (Morgan, 2012). As a new language of technology develops over this new millennium, Krashen (1982) and Delpit (2006) language development research identified how stress established a high affective filter with negative effects on knowledge and student content mastery. In under resourced schools with students lacking routine access to current technologies, Pope, Hare, and Howard (2002) found computer-based assessment of elementary students with limited technological competencies negatively impacted student confidence with negative results on student performance.

**Early-Childhood Development**

Vygotsky (1978) believed that early-childhood cognitive development was student-centered and socially oriented. Piaget's (1970) theory of cognitive development suggested that children construct meaning through learning activities that shape understanding their personal experiences in relation to current knowledge and past experiences (Howard, McGee, Schwartz, & Purcell, 2000). In a socially constructed classroom, elementary school students investigate the world and collaborate to construct, or build, their own knowledge from interactions. Dawes, Mercer, and Wegerif (2000) found that the early-childhood classroom environment required a participatory culture that valued individual member contributions and teaching early-childhood students to collaborate through negotiating tasks and sharing ideas. Collaboration sparked student development and critical understanding of one's own world.

Schools should consider the social outcomes of learning and use multiple forms of literacy, or multiliteracies, as they structure learning in the social classroom (New London Group, 1996). Teachers scaffold students' learning within the early-childhood classroom by structuring multiple opportunities to share experiences with the teacher and classroom peers (Gomez et al., 2014). Furthermore, DeVries and Zan (1994) explained that the early-childhood classroom provided for the advancement of student understanding and dispels misconceptions through scaffolded discussions and meaningful interactions within the constructivist social classroom. These early-childhood educational activities engaged students' interest and encouraged active experimentation (Gomez et al., 2014).

**Achievement Gap**

Many teachers work in school cultures that support success (Maier & Youngs, 2009), under resourced urban school districts struggle with inadequate resources and challenging learning environments (Morgan, 2012). The No Child Left Behind Act of 2001 highlighted the economic and racial disparity with aggregated data on minority and low-income groups: "Only 40% of low-income third graders met the state's reading standards, compared with 75% of their classmates who were not considered disadvantaged students, and the reading results for Grades 5 and 8 were similar" (Morgan, 2012, p. 4).

While the United States looks to dominate world culture, McKinley (2010) reported that the United States consistently ranks average to below average in science and math as compared to similar industrialized nations such as China and countries throughout Europe. McWhorter (1997) asserted that "forty years after the Civil Rights Act . . . African American[s] still perform lower than any major racial or ethnic group in the [United States], at all ages, in all subjects, regardless of class" (p. 2). Decades later, the achievement gap still exists among similar groups as measured via achievement tests such as the National Assessment of Educational Progress (NAEP) and the Programme for International Student Assessment (PISA; Cook & Evans, 2000; Gonzales, Cauce, Friedman, & Mason, 1996; Herrnstein & Murray, 1994; Simmons, 1999; Singham, 1998; Spradlin, Welsh, & Hinson, 2000).

The Organization for Economic Cooperation and Development (OECD) administered the PISA tests. A widening achievement gap can still be seen within aggregated racial and economic data. Brozo, Shiel, and Topping (2007) described African American and Hispanic students in the United States ranked 25th out of 32 countries, as compared to Caucasian students in the United States who ranked second out of the 32 countries. McKinley (2010) further commented that "the fourth largest gaps are between students of high and low socioeconomic status (with the latter group comprising primarily students of color)" (p. 4).

**Culture of Testing**

PISA influences international education policy which, in turn, drives national, state, and local educational policies. According to Stewart (2012), PISA testing and subsequent rankings spark global competition and drive the domestic testing culture. National Assessment of Educational Progress (NAEP) assessment tool measures domestic academic progress of American students. Grissmer, Flanagan, Kawata, and Williamson (2000) described NAEP's purpose to improve education through structural educational reforms that "introduce competition" and subsequently structure accountability by focusing meeting achievement standards with "report cards" that grade standards performance on national, state, and local levels (p. iv). Furthermore, PISA and NAEP rankings drive the testing culture through competition with the global economy. The 2012 cycle of Programme for International Student Assessment (PISA) focused on reading and mathematics, and the assessment results indicated that the United States ranks 27th out of 34 industrialized nations and falls below the international average in mathematics (Appendix A).

Furthermore, Stewart (2012) suggested that global competition drives educational businesses to research best practices and sell successful strategies from high-performing educational markets. The commercialization of best practices increases educational spending, drives business revenues, and contributes to a "competition-oriented approach to education" and a culture of standardized testing (Stewart, 2012).

**Digital Literacies**

State of Louisiana Department of Education (2016) defined digital literacy as "the ability to use technology to find, evaluate, create, and communicate information" (p. 1). Critical thinking is essential to the foundation of digital literacy skills (Jenkins et al., 2009). Scheibe (2004) further defined digital literacy as an incorporation of multiple literacy skills so that the learner can use technology to develop higher conceptual understanding of content and apply learning to relevant tasks beyond the classroom. According to the Digital Literacy Task Force of the American Library Association, digital literacy also requires the development of cognitive and technical skills so that students can use critical thinking to communicate, plan, and resolve issues ("How Digital Literacy is the Foundation of Academic Success," 2013, p. 26).

State of Louisiana Department of Education (2016) published the "Technology Readiness by Grade Level" chart (Appendix B), with digital literacy organized into eight categories:

- Basic computer operations,
- Word processing,
- Spreadsheets,
- Mathematical applications,

- Presentation and multimedia tools;
- Acceptable use, copyright, plagiarism, and online safety;
- Research and information gathering, and
- Communication and collaboration.

The categories have associated skills labeled with *M* for “Master the concept,” *R* for “Reinforce the concept,” *I* for “Introduce the concept,” or *O* for “Optional at this grade level” (p. 2).

According to the “Technology Readiness” chart (Appendix B), third grade students must have mastered the following basic computer operation skills: identify basic terms and usage of technology, understand computer file management, and use online tools and resources for assessment and web browsing. The “Technology Readiness” suggests introducing keyboarding in first grade with reinforcement from second through fourth grade. With keyboarding mastery recommended by fifth grade, third grade students must master “using a word processing application to write, edit, print and save simple assignment” and “use menus and toolbar functions (e.g. font, style, line spacing, and margins) to format, edit and print a document” (State of Louisiana Department of Education, 2016, p. 3). These third grade word processing skills require foundational keyboarding skills. Other important digital literacy skills expected for third grade mastery include multimedia skills of watching online videos for notetaking. Furthermore, students are expected to master compliance with acceptable use and explain responsible uses of technology and digital information (State of Louisiana Department of Education, 2016).

Digital literacy skills also involve adapting and using technology to research, plan, communicate, and express oneself in a fast-evolving technological age (Chow, Smith, & Sun, 2012). According to Chow et al. (2012),

> Children over six begin to develop more advanced technological and cognitive skills--they start to understand digital avatars represent characters they can take care of and become friends with. Their overall tolerance threshold is higher; they tend to still follow rules explicitly, and in general are more skilled with the computer, mouse, and user-ids and passwords. (p. 89)

Students gain new knowledge in multiple ways in the new digital age compared to traditional textbooks (Pinkard & Austin, 2014). Gonzales (2004) commented,

> Half of what is known today was not known 10 years ago, the amount of knowledge in the world has doubled in the past 10 years and is doubling every 18 months according to the American Society of Training and Documentation (ASTD). (p. 54)

With the rapid evolution of knowledge with current technologies, students must demonstrate 21st century skills and use multiple forms of literacy, to understand, produce, and transform information with digital technologies (Gomez et al., 2014).

**Digital Divide: Access, Use, and Application**

Common Core State Standards and the ESSA (2015) collectively called for developing competent students in the 21st century global economy (National Governors Association Center for Best Practices, 2010a). Students have more access to mobile phones, smartphones, and tablets resulting in high volumes of passive digital content consumption (Ito, Baumer, Bittandi, Boyd, Cody, Herr-Stephenson & Horst, 2010). While checking email, texting friends, and digital banking have become synonymous with the current digital age, Ito et al. (2010) found that students use technology more; however, they do not know how to analyze and synthesize using technology, nor do they know how to create such technology.

Even with a 4,207% growth in internet access in the United States from 2000 to 2016, only 78% of all U.S. households have internet access (Internet World Stats, 2016). Of the 78% only 70.3% of Louisiana households have high-speed internet. Even though 83.1% of Louisiana households have computers (U.S. Census Bureau, 2014), the digital divide issue has evolved from physical computer access to inequalities in use and types of technologies (DiMaggio et al., 2004).

When comparing ownership of computers to mobile phones, U.S. Census Bureau (2014) found that African American and Hispanic households mostly reported only having a mobile device. Additionally, low-income households also reported only owning a mobile device at significantly higher rates than those of more affluent households. Kim and Kim (2001) explained that the "key to bridge the digital divide is not access to or utilization of high-tech information devices, but whether the user knows how to use them for the betterment of their quality of life" (p. 85).

While Warschauer (2003) found that the digital divide does not exist in terms of physical access to computers, Mossberger, Tolbert, and Stansbury (2003) suggested that students lack the necessary skills to equitably use technology and that technology skills have "taken a backseat" (p. 1). Pope et al. (2002) extended the digital divide from an access issue to concern about necessary skills development by educators to train students to use and apply technology skills within classroom learning and assessment.

**Digital Natives Versus Digital Immigrants**

Prensky (2005) defined digital natives as students raised in an era saturated with various forms of technology and digital content. Considine et al. (2009) explained that "digital natives are fluent in the language and culture of ICT, adjusting easily to changes in technology and using

ICT in creative and innovative ways" (p. 473). Emanuel (2013) simply described the primary role of digital natives as using technology in daily life. On the contrary, digital immigrants are those individuals born before the "rapid infusion of technology" and struggle with learning and applying ICT skills (Prensky, 2005, p. 4). With the digital native category defined as the Millennial generation born between 1983–present day, most veteran and practicing educators fall within the digital immigrant category, defined as being born before 1983 (Emanuel, 2013). While digital immigrants had to initially learn how to use technology and may struggle with understanding newer technologies, digital natives were born into an online societal culture infused with technology regardless of external socioeconomic factors (Emanuel, 2013; Prensky, 2005). While the digital divide exists, digital natives within marginalized communities may not own or have regular access to technology, but still embrace newer technologies better than do digital immigrants (Gomez, Gomez, & Gifford, 2010).

**Digital immigrant educator effects on digital native technology use.** While the use of technology has increased over the past 30 years, in a study on technology integration and closing the achievement gap, Pope et al. (2002) found that technology integration within elementary schools and teacher preparation has not been fully realized. Digital immigrant educators have limited access to formal ICT training from digital immigrant teachers and administrators slow to embrace new technologies (Gomez et al., 2010). Digital immigrant educators struggle to facilitate the technological use and skills development of digital natives. Furthermore, Pope et al. (2002) and NCES (2000) both found that most teachers reported word processing as the highest use for computers in the classroom.

Considine et al. (2009) questioned the preparation and effectiveness of digital immigrant classroom environments to engage and develop the necessary ICT skills of digital natives.

Furthermore, digital immigrants' confidence using the computer to teach affected the amount of technology integration within the classroom. Martin and Briggs (1986) found a high correlation with computer anxiety and negative attitudes toward using computers within the classroom. As a result, digital immigrants find ways to place restrictions on internet and social networking sites with misguided intent of protecting students (Considine et al., 2009). School districts led by mostly digital immigrant administrators fail to realize that these technologies are important "ways in which today's youth communicate, think, express themselves, and contribute and receive information" (Chow et al., 2012, p. 89). Additionally, marginalized communities and schools with limited technologies may not regularly offer technology classes, and if they do, they are low-level technology experiences lead by a digital immigrant (Margolis et al., 2008). The lack of technology integration by digital immigrants can impact the technology skills development of the digital native student.

Digital immigrant teachers educating digital native students in marginalized communities must find innovative ways to support and develop technology skills development (Warschauer & Matuchniak, 2010). Providing basic technology classes for digital immigrant teachers is not enough. Pope et al. (2002) found that modeling technology instructional methods reduced teacher anxiety and improved teacher confidence levels as well as instructional use of technology in the classroom.

**Technology policy implications in early-childhood education.** The American Academy of Pediatrics (AAP) (2016) agreed that media technology increases knowledge acquisition through social communication and exposure to new ideas through digital messages and information. However, they also cited certain risks of "negative health effects on weight and sleep; exposure to inaccurate, inappropriate, or unsafe content and contacts; and compromised privacy and confidentiality" in their recommendation of "no more than two hours of screen time a day" (AAP, 2016, p. 2). With early-childhood technology use as an emerging field of educational research (Ashbrook, 2017), policy recommendations have been fast, ongoing and sometimes premature. School districts and early-childhood programs often cite the recommendation to limit the use of technology within early-childhood classroom instruction. Recognizing the increased technology access within PK–12 schools, the NAEYC and Fred Rogers Center (2012) suggested intentional and appropriate use of technology and interactive media with children from birth through age 8 (NAEYC and Fred Rogers, 2012, Lovely & Moberly, 2012). Furthermore, the NAEYC and Fred Rogers joint policy statement advocates for more research and professional development on the use of educational media and digital tools in early-childhood programs due to the rapid evolution of technology.

Digital immigrant educators struggle to facilitate digital native technology learning by placing heavy restrictions on newer technologies to avoid problems with digital native students (Considine et al., 2009; Lovely & Moberly, 2012). Instead of restricting sites and social media platforms, digital immigrant educators need constant education and information to embrace new technologies and "how-to" resources to "effectively select, use, integrate, and evaluate technology and interactive media tools in intentional and developmentally appropriate ways" (Lovely & Moberly, 2012, p. 3).

**Sociocultural–Constructivist Theory**

Vygotsky's sociocultural developmental theory (1978) defined student learning in terms of socialization and collaboration. Within an early-childhood and elementary classrooms, language and social interactions contribute to the scaffolding of children's learning (Vygotsky, 1978). As children construct knowledge and understanding from their interactions within this social classroom, the constructivist classroom exists through social discourse and knowledge development. According to Jonassen, Tessmer, and Hannum (1999), constructivist teachers facilitate learning through collaborative projects. Constructivist theory establishes cognitive development as student-centered and socially oriented learning through discoveries, interactions, reflections, and personal experiences (Howard et al., 2000). Vygotsky (1978) similarly viewed individual development as social and collective; therefore, individual and societal cultures and values influence child development. Vygotsky stated, "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people and then inside the child. . . . All the higher functions originate as actual relationships between individuals" (p. 92).

Wilson (1996) defined a constructivist learning environment as a collaborative place where students use tools and resources to complete problem-solving activities. DeVries and Zan (1994) described the constructivist classroom in terms of engaging students' interest and providing peer interactions coupled with student self-responsibility. Sociocultural, constructivist learning approaches within the ICT framework encourage students to discover and share new technological skills.

**Collaborative–Connectivist Learning Theory**

Within a social, constructivist classroom, collaboration is a cognitive process of constructing shared meanings through multiple interactions and revisions of shared knowledge within a common task (Roschelle, 1992). Vygotsky (1978) established that social interactions result in "individual cognitive change" through "cognitive conflict." The resolution of this cognitive conflict results in new understandings (Dillenbourg, Baker, Blaye, & O'Malley, 1996). According to Hohlfield, Ritzhaupt, Barron, and Kemker (2008) ICT framework, participants use

ICT knowledge to collaborate on the completion of a coding module through pair programming. Pair programming provides a collaborative learning culture that allows student-participants to build programming skills through individual and shared learning opportunities (Zhong et al., 2017). This collaborative process challenges participants to conceptualize, communicate, and provide feedback to a peer as either a driver or navigator. By sharing challenges and suggestions, student-participants develop their technology skills with a peer in a lower affective filter environment. The shared skills development through pair programming contributes to higher confidence and hopefully positively affects participants' ability to develop computer game segment within a higher, empowerment, level of Hohlfield et al. (2008) ICT framework.

Connectivist learning theory, while unique to the digital age, builds upon constructivism and promotes new learning activities developed under a collaboration framework of four steps: (a) collection, (b) reflection, (c) connection, and (d) publication (Del Moral, Cernea, & Villalustre, 2013). This digital learning occurs through different interactions with various communities and sources of knowledge. Furthermore, participants use an ICT framework to engage in digital learning structured around common interests and individual and/or group tasks (Siemens, 2005). The connectivist learning theory informs how students use technology to build 21st century skills and engage with peers through collaboration and shared perspectives. As Jenkins et al. (2009) related collaboration with the term *participatory culture,* the collaborative–connectivist learning theory empowers students to collect and manage information (collection), provide self-reflection throughout one's own learning (reflection), engage in meaningful interaction with building a "collective intelligence" (connection), and use shared learning to create a digital creation (publication; Gomez et al., 2014).

**Affective Filter Theory**

Affective filter theory is a concept of educational psychology with three constructs: anxiety, motivation and self-confidence (Krashen, 1982). These emotional factors interfere with understanding and cognition. Krashen and Tracy (1982) found that stressful learning environments negatively impact language development resulting in lower knowledge acquisition. Ghaderi and Nikou (2016) described the affective filter as "a mental wall that raises in a student's head reducing or effectively shutting their ability to learn" (p. 8). Krashen (1982) defined a high affective filter as a learning environment or situation with high anxiety, low motivation, and low self-confidence. On the contrary, a low affective filter had low anxiety, high motivation, and high self-confidence (See Figure 1).

Krashen believed that constant language development in low stress learning environments provided the path to lowering the affective filter. Krashen (1982) suggested that complex negative emotional factors interfere with cognitive reception and processing of new language within the classroom. Gomez et al. (2014) argued that sociocultural nature of language requires that new literacy must extend past traditional reading, writing, and oral forms of communication to include multiliteracies for building digital literacy and 21st century skills. Furthermore, Krashen (1982) and Delpit (2006) contend that stressful classroom learning situations (i.e. assessments) can impact student knowledge demonstration and application on student tasks and assessments. High affective filters can create mental blocks due to high anxiety and low self-confidence during testing.

Digital natives with limited technological competencies have a high affective filter when completing computer-based testing because the students would have a high level of stress manipulating technology resources on an assessment measuring core-content (Delpit, 2006).

Delpit (2006) further contended that stressful, high affective filter environments lower student performance.

Common Core State Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010b) and State of Louisiana Department of Education (2016) guidelines require new digital language development in the form of digital literacy. While early-childhood digital natives have access to various forms of technology, the same students in marginalized communities have an increased affective filter when introduced to online testing with limited use of technologies within the classroom. Delpit (2006) and Krashen (1982) suggested that the affective filter negatively impacts student performance. Furthermore, teaching and learning must reduce the affective filter so that students can acquire the new technological language needed for students from marginalized communities to be successful on computer-based tests.

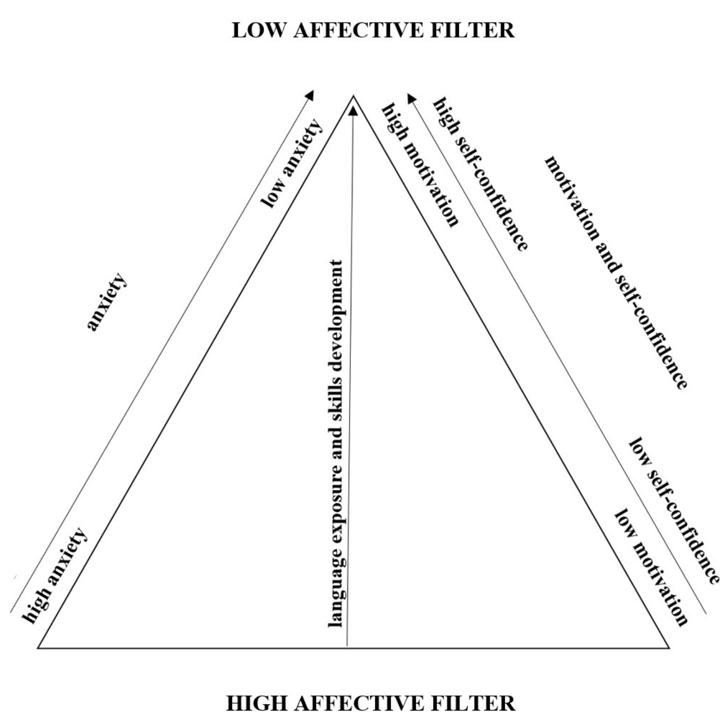



*Figure 1*. Affective filter framework - adapted from (Krashen, 1982, Delpit, 2006).

Digital immigrants educating digital native students in marginalized communities must find innovative ways to support and develop technology skills development (Warschauer & Matuchniak, 2010). The technology integration study by Pope et al. (2002) found that modeling technology instructional methods reduced teacher anxiety and improved teacher confidence levels and instructional use of technology in the classroom.

**ICT-Digital Divide Framework**

Hohlfield, Ritzhaupt, Barron, and Kemker (2008) outlined the levels of digital divide in schools to describe a foundational approach explaining the evolution of the digital divide. Access to internet, technology, and computer hardware and software make up the foundational level of digital use. Hohlfield et al. (2008) defined this school infrastructure level as "student-to-computer ratios, teacher-to-computer ratios, internet access types, and technical personnel within a school" (p. 1650). The classroom level represents student and faculty frequency of classroom computer use. Margolis et al. (2008) contended the digital divide has evolved from the issue of access to a physical computer, Hohlfield et al. (2008) model depicts a foundational level of access to technology infrastructure, which leads to routine technology use and eventual self-guided technology creation and implementation.

The digital divide evolves from the foundational, first level of access to the second level which involves the digital use of technology within the classroom by teachers and students Hohlfield at al. (2008). Gomez et al. (2010) found that technology use in schools is uneven and schools are reluctant to embrace new technologies. The level of engagement with technology use stems from levels of technical expertise from teachers and parents. Gomez et al. (2014) found that schools need to be the bridge to the digital experience divide, but they lack the high-level computing knowledge to meet the needs of students. Hohlfield at al. (2008) ICT-Digital

Divide framework supports the notion that students engage in coursework that builds digital media literacy and 21st century learning skills (see Figure 2).

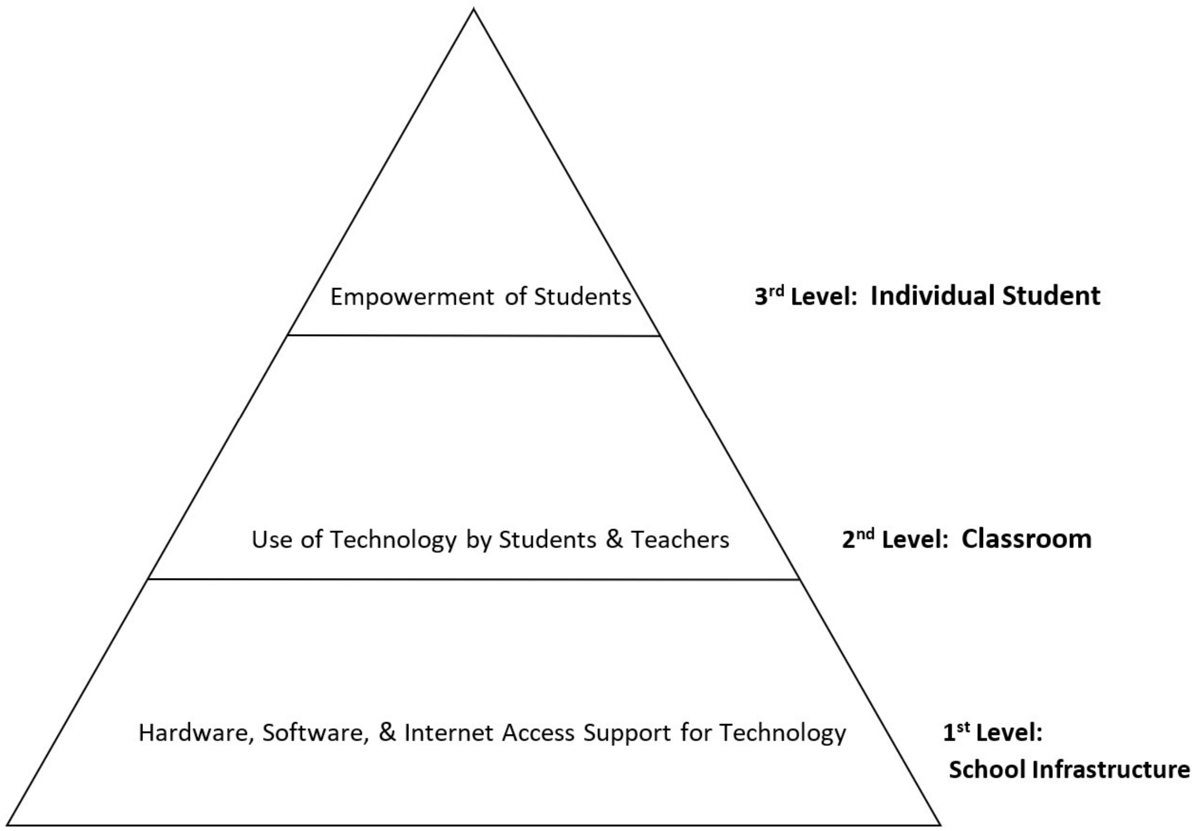



*Figure 2*. ICT-Digital Divide framework diagram of the levels of the digital divide in schools (Hohlfield et al., 2008).

Barron, Walter, Martin, and Schatz (2010) described students in marginalized communities with limited access to computers attempting to self-learn computer skills because their schools do not offer technology classes. The disparity between socioeconomic levels becomes apparent with the second Hohlfield at al. (2008) ICT-Digital Divide framework level. Margolis et al. (2008) found that minority students participate in low-level learning opportunities with computers and that their schools servicing do not offer courses to challenge high-level use of computer technology skills. The second level ICT-Digital Divide Framework also suggested that access involves digital use of technology that prepares students to "communicate, produce, and design with technology" (Hohlfield et al., 2008, p. 3). These computing skills involve what Jenkins et al. (2009) described as digital literacy skills at the heart of students' ICT competency, which include a working knowledge of essential computer components and software.

The pinnacle of the Hohlfield at al. (2008) ICT-Digital Divide framework is the third level. It extends knowledge of ICT skills to the application of ICT competency for student empowerment. Comparable to Maslow's (1943) hierarchy of needs which defines self-actualization as the penultimate level of self-understanding of one's needs, this framework suggests that ICT competency empowers students to use technology to learn about the world on their own. Kim and Kim (2001) explained that the key to bridge the digital divide is the development of opportunities for students to learn how to utilize technologies for a higher quality of life.

Furthermore, Delpit (2006) contended that minority students within marginalized communities with limited technologies need specific learning opportunities to develop critical thinking skills regarding technology. According to Delpit,

> A "skilled" minority person who is not capable of critical analysis becomes the trainable, low-level functionary of the dominant society, simply the grease that keeps the institutions which orchestrate his or her oppression running smoothly. On the other hand, a critical thinker who lacks the "skills" demanded by employers and institutions of higher learning can aspire to financial and social status only within their disenfranchised underworld. (p. 19)

Ritzhaupt et al. (2013) confirmed the limited research literature on effective measurement of ICT skills for student empowerment. Therefore, the current research study involved digital native students in a school with a foundational level of technology access, yet they do not possess the necessary technology skills as per second level of Hohlfield at al. (2008) ICT-Digital Divide framework. The research was aimed to measure the impacts of a structured technology intervention with the development of technological competencies necessary to build confidence on computer-based tests.

**Conclusions**

While the literature on digital divide and ICT skills competencies is focused on middle and high school communities, the digital divide has evolved from a term of mere access to a combination of access, usage, and skill (Ritzhaupt et al., 2013). Prensky (2001) defined a digital native as an individual growing up in a world with technology. As these connected individuals passively consume technology, they lack the necessary ICT skills to effectively create and use technology for high-intellectual impact. Common Core State Standards require students to use technology to complete research and synthesize digital content in various forms, so "it is important to equip all students with the tools necessary to complete these tests" ("Digital Literacy: Preparing Students for a Global Tech-Based Economy," 2012, p. 7).

The digital divide has evolved from physical access of technology to using technology. Digital natives have access to various forms of digital media content, but do not have the necessary skills to actively use digital media for content learning (Ito et al., 2010). Furthermore, the problem is further exacerbated in marginalized schools due to limited technological competencies and lack of high-level technology learning (DiMaggio et al., 2004). Some of these individuals may have access to smartphones and tablets, but not to a standard computer. The access to technology represents the foundational level of the Hohlfield at al. (2008) ICT-Digital

Divide framework. Gomez et al. (2014) found school inconsistencies with technology use and availability.

The second level of Hohlfield at al. (2008) ICT-Digital Divide framework builds upon the foundational access level to include technology use by students and defines high-level technology skills development as the ability to “communicate and design with technology” (Gomez et al., 2014, p. 3). Furthermore, the top tier of ICT-Digital Divide framework involves student empowerment demonstrated through utilizing ICT competence to further own understanding of the world. Application of technological language can apply to various content areas within the standard classroom. Finally, ICT-Digital Divide framework must include sociocultural learning that reduces the technology affective filter (Hohlfield et al., 2008). To narrow the achievement gap in marginalized communities, early-childhood classrooms must have a 21st century curriculum that allows students to navigate the ICT-Digital Divide framework through routine, consistent access (Tier/Level 1), high-level use (Tier/Level 2) and application/creation (Tier/Level 3) of technology.

A gap in research exists with early-childhood education (ECE) and information communication technology (ICT). Primary schools provide a wealth of new research opportunities to creatively integrate ICT skills within core-content areas. The literature review synthesized typical ECE classroom learning pedagogies of constructivism, collaboration, and shared learning within a typical social classroom. As the Hohlfield at al. (2008) ICT-Digital Divide framework requires scaffolding of technology skills to reduce the affective filter and stress of learning a new technological language, innovative instructional technology learning must occur within early-childhood classrooms to promote higher technological skills content so that students can demonstrate content mastery on computer-based testing (CBT). This research study investigated the effects of a digital literacy intervention on student performance in social studies and mathematics through the reduction of the technological affective filter in third grade students with limited technologies competencies.

# CHAPTER THREE

## RESEARCH DESIGN AND METHODOLOGY

This chapter includes an overview and brief description of the research study design. First, the chapter discusses the rationale for conducting this research study. Then, the research design describes the target population and, introduces a technology affective filter digital divide framework adapted from the ICT-Digital Divide framework (Hohlfield et al., 2008) along with the affective filter theory (Delpit, 2006, Krashen, 1982). This section discusses how the theoretical framework guided the digital literacy intervention development. Then, the chapter displays the details of both interventions with conceptual framework diagrams and describes the research procedures implementation. The chapter then discusses the instruments used within the research study and operationalizes the measurements of main concepts (performance, CBT-confidence) used to answer the research questions and test the hypotheses. The chapter concludes with a discussion of validity with instrumentation and intervention design, and a description of data collection and analysis procedures.

The research design of this quasi-experimental quantitative study involved a sample population of two third grade cluster group classrooms (n=41) at ABC Elementary. One cluster group served as the intervention group. The other cluster group served as the control group. During the first week of the research study, both participant groups participated in computer-based pretests in social studies and mathematics. After each pretest, participants completed a short online Likert-style survey to measure participant computer-based testing confidence (CBT-confidence) in social studies and mathematics. Participants also completed an online technology use baseline survey to measure technology use at home.

After the first pretesting week, the intervention group received a digital literacy intervention of computer coding and keyboarding in a regular 30-minute schedule on Monday, Wednesday, and Friday for four weeks during the social studies and science instructional block. The control group received a mock intervention during the same social studies and science instructional block to reduce contaminator effects. After the four-week intervention, both groups completed computer-based posttests to measure overall student performance in third grade social studies and mathematics. After each posttest, participants completed an online survey to measure overall CBT-Confidence in social studies and mathematics.

The research study compared the overall student performance and CBT-confidence from pre to posttest in social studies and mathematics between intervention and control groups. Linear regression analysis and ANOVA were conducted to understand the relationship between overall student confidence with CBT and overall student performance in social studies and mathematics. Furthermore, the research study conducted separate regression analysis and ANOVA on the intervention variables to determine if the coding variables of the digital literacy intervention had significant relationship on overall CBT-confidence in social studies and mathematics.

**Rationale**

This quasi-experimental quantitative study focused on evaluating the effects of a digital literacy intervention (coding and keyboarding) verses a mock intervention (access to *Scholastic News – Grade 3* digital magazine) on student performance and confidence with computer-based testing (CBT) in third grade social studies and mathematics. Early-childhood students take standardized testing for the first time in third grade. Students must understand a language of standardized computer-based testing to show content mastery as set forth by state departments of education (Grissmer et al, 2000). The State of Louisiana Department of Education (2016) provided guidelines of technology readiness by grade level so that third grade students can complete new standardized assessments via CBT that align with Common Core State Standards. The achievement gap widened with technology access for students in marginalized and under resourced communities (Gomez et al., 2014). Chang suggested that access and training with technology can possibly close the achievement gap (2017). This research study intended to determine the impact of student CBT-confidence on student performance in high-poverty schools with limited technologies. The research site selection involved finding a high-poverty school with limited technologies in a large suburban metropolitan area. The research study focused on social studies and mathematics because of the researcher's familiarity with the content standards and grade-level expectations.

**Research Design**

The Institutional Research Board of Xavier University of Louisiana and school administration approved this research study. Prior to the start of research study, the researcher, also a teacher at ABC Elementary, obtained written informed consent from parents and third grade participants at ABC Elementary. To ensure student privacy and confidentiality with conducting research in a public school, the researcher verified proper student privacy documentation of involved websites: Code.org, Typing.com, and EAGLE2.0.

While serving in a role as teacher at ABC Elementary, the teacher-researcher completed school district student privacy training to maintain security of personally-identifiable information (PII) to protect student data and privacy rights. Researcher coded student data with a participant identification (PID) number not linked to any personally-identifiable information to maintain student privacy rights.

**Population.** According to the State of Louisiana Department of Education (2017a) District Report Card, approximately 4,160 third grade students (8.5%) enrolled in a school district with a total population of 48,835 students. During the 2016-2017 academic year, the ethnic diversity of this suburban school district population was reported as: 41% African American; 27% Caucasian; 24% Hispanic; 5% Asian; 1% Native American/Alaskan Native, or Pacific Islander; and 2% Multiracial.

In this school district, ABC Elementary school population consisted of 434 students from grades pre-kindergarten to fifth grade, during the research period (Spring 2018). The third-grade enrollment of 70 students within three classrooms constituted 16.1% of overall ABC school population. The third grade students ranged from 8 to 9 years of age and represented the latter part of the early-childhood education (PK–third grade) spectrum. According to the State of Louisiana Department of Education (2017b) School Report Card, ABC Elementary school served a school population that was 94% economically disadvantaged and included 90% of under-represented minority students (49% African American, 37% Hispanic, 3% Asian, and 1% Multiracial) and 10% Caucasian students. The School Report Card also reported a school Technology-Use ratio of 1.6 students per device. The third grade teachers share 35 laptops with 70 total students which made the actual Technology-Use ratio 2.0 students for every computer.

**Sample.** Two third grade classrooms at ABC Elementary served as the measured population of this quasi-experimental quantitative study. The sample represented in this research study consisted of 41 Grade 3 students ($n$ = 41) within two intact classrooms. One classroom ($n$ = 20) received the digital literacy intervention and the other classroom ($n$ = 21) received the mock intervention as the control group. The English Language Learner classroom was not used because it did not reflect similar academic demographics of the other two third grade classrooms.

The teacher-researcher taught the third grade social studies content and the third grade mathematics teacher delivered the mathematics instruction to the participants at ABC Elementary.

**Technology Affective Filter Digital Divide Framework**

The research study involved a technology affective filter digital divide framework adapted from Krashen (1982) and Hohlfield et al. (2008) to reduce digital divide and technology affective filter barriers through scaffolding technology skills development. This research study's framework incorporated Krashen (1982) affective filter framework finding that self-confidence, anxiety, and motivation barriers limit knowledge acquisition (see Figure 1). The technology affective filter barriers are lowered as individuals develop a language of technology through computer skills development.

The theoretical framework merged the affective filter framework (Krashen, 1982) with ICT-Digital Divide framework (Hohlfield et al., 2008) to incorporate tiered-technology skills development (see Figure 2). This theoretical framework reduced the digital divide through routine technology use, targeted ICT skills development with computer coding, and applied these ICT skills for technology development. This technology affective filter digital divide framework gradually increased self-confidence with technology and reduced the affective filter and digital divide barriers by providing basic access and foundational keyboarding skills through Typing.com (n.d.) activities, developing ICT skills through coding and debugging coding puzzles, and empowering students through application of ICT skills to create a video game segment (see Figure 3).

The foundational level of the technology affective filter digital divide framework (adapted from Hohlfield et al., 2008, Krashen, 1982, Delpit, 2006) suggested providing students access to basic computing infrastructure with keyboarding skills development for logging onto school accounts and typing standard digital compositions. While considered a low-level task, keyboarding skills provide high anxiety for individuals with low technology competencies because students struggle with logging onto secure testing websites (i.e. EAGLE 2.0) with unique passwords using combinations of upper and lowercase characters and numbers. Furthermore, typing/keyboarding fluency affect how students compose and revise digital compositions.

This access tier (see Figure 3) of the technology affective filter digital divide framework (adapted from Hohlfield et al., 2008, Krashen, 1982, Delpit, 2006) exposes participants to essential keyboarding skills necessary for entering passwords using the SHIFT key with upper and lowercase words, and typing constructed responses with proper capitalization, punctuation, and symbols. For purposes of this portion of the digital literacy intervention, keyboarding skills serve as a form of access support for technology. Keyboarding skill development, at the foundational level, enable access to technology.

While keyboarding and routine computer access provide foundational use, the theoretical framework suggests that the second tier involve greater use of high-level technology (i.e. coding) for the continued development of a language of technology. During this stage, participants develop specific technological skills of computer coding. The technology affective filter digital divide framework proposes that confidence increases as the individuals continue technology skills development through routine technology use within the classroom. The final tier of the theoretical framework involves a project that serves as a synthesis of the technology skills developed through the digital literacy intervention. Through the routine access and skills development, the participant develops a strong language of technology that provides confidence and empowerment at the higher level to create technology. This final level of the technology affective filter digital divide framework also depends upon necessary technological skills development within the prior tiers for the successful demonstration of higher technology skills with higher confidence and low anxiety (lower technology affective filter). The hallmark of the technology affective filter digital divide framework posits that technology access combined with routine technology use empowers greater technology confidence while lowering technology affective filter barriers.

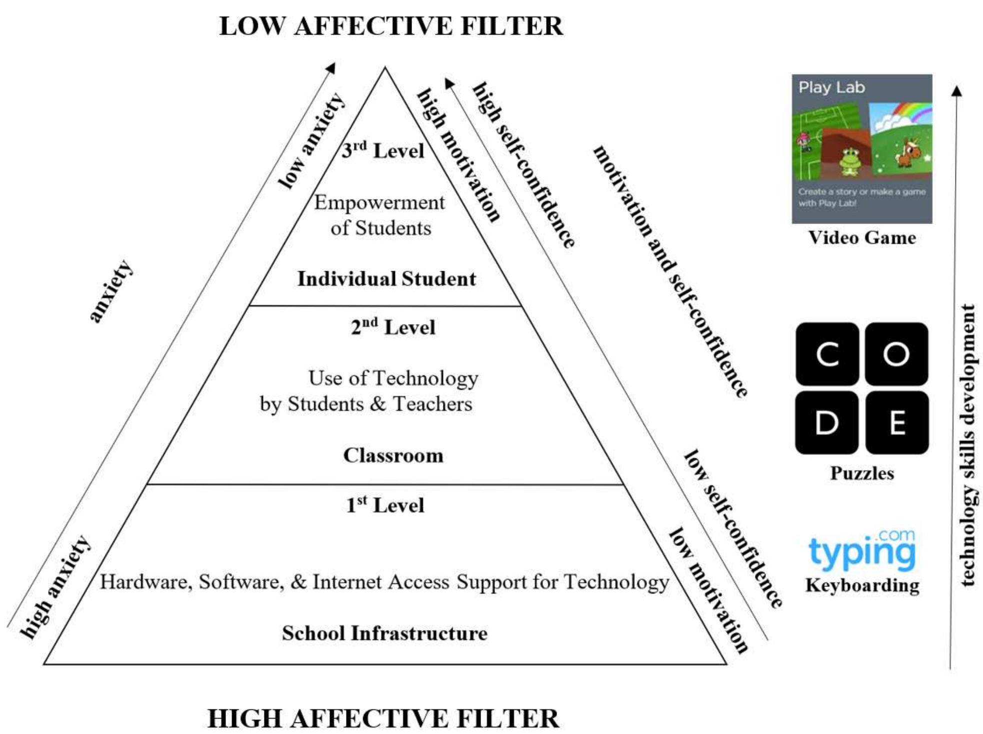



*Figure 3*. Technology affective filter digital divide framework (adapted from Hohlfield et al., 2008, Krashen, 1982, Delpit, 2006).

## Intervention

This research study employed an intervention to decrease the technology affective filter measured as CBT-confidence and assess the impact of student performance on computer-based testing in social studies and mathematics. The research study identified two groups: the intervention group who completed the digital literacy intervention and the control group who completed the mock intervention. The teacher-researcher designed and implemented the interventions during the science/social studies instructional block. The following is a detailed description of each intervention.

**Digital Literacy Intervention.** The digital literacy intervention involved a 3-step technology affective filter digital divide framework to gradually provide access and foundational keyboarding skills through using Typing.com (n.d.) activities, developing ICT skills to program and debug coding puzzles, and empowering students to through technology applications to create a video game segment. The State of Louisiana Department of Education (2016) defined necessary third grade ICT skills as, "1. Basic computer operations (coding, keyboarding), 2. Word processing (keyboarding), 3. Presentation and multimedia tools (coding), 4. Acceptable use and online safety (coding, keyboarding), 5. Research and information gathering (coding), and 6. Communication and collaboration (coding)" (pp. 2–8).

**Typing.com keyboarding modules**. The participants in the intervention group completed Typing.com (n.d.) keyboarding modules, which started with the beginner course and self-progressed through 14 keyboarding lessons to build keyboarding fluency. Typing.com component of the digital literacy provided self-paced keyboarding modules that tracked average typing speed per module. Participants could repeat modules to correct errors and increase typing speed.

**Code.org – Course C curriculum modules.** Considering that students at ABC Elementary do not use instructional technology beyond the foundational ICT level, the intervention went beyond the foundational level of technology use and provided further development of technology skills through Code.org – Level C curriculum as aligned with International Society for Technology in Education (ISTE) (2016) standards for students (Appendix C). The Code.org description of Course C included, "Students will create programs with loops and events. They will translate their initials into binary, investigate different problem-solving techniques…. By the end of the course, students will create interactive games that they can share" (n.d., para. 1).

The research study implemented Code.org – Course C curriculum designed for second grade students to scaffold technology support of students new to the concept of computer programming. The digital literacy intervention included this introductory level Code.org – Course C curriculum to reduce the technology affective filter for these novice computer programmers.

The coding component of the digital literacy intervention included 123 puzzles involving either a computer programming or debugging concept which were organized into 10 modules and built upon the previous puzzles within each module. Throughout these scaffolded puzzles, debugging skills built upon the progress through levels in the modules so that the participants could identify and correct errors within programmed code. Students enhanced critical and computational thinking skills by working backwards to problem solve puzzles with coding errors (Standard: NETS.S-6: Technology Operations and Concepts) (ISTE, 2016). To assist with computer programming challenges, several lessons involved the concept of pair programming (PP), in which participants work together to solve challenging coding and debugging puzzles. This collaborative problem-solving strategy helps resolve coding challenges with computational thinking while working with fellow teammate to discuss and resolve programming and/or debugging issues (ISTE Standard: NETS.S-3: Research and Information Fluency) (ISTE, 2016).

**Pair programming (PP).** While the modules served to scaffold coding and debugging skills development through building upon skills from previous puzzles, the research study incorporated PP to provide a collaborative learning culture that allows student-participants to build programming skills through individual and shared learning opportunities of complex concepts (ISTE Standard: NETS.S-2: Communication and Collaboration). Zhong et al. (2017) defined PP as a software development technique or practice involving two programmers working together at one computer. Within a typical PP session, one participant, the driver, proceeded through the coding puzzles with the help of another student, the navigator. The navigator observed the driver's work, reviewed the keyboarded code, and provided support by pointing out potential errors and offered ideas to problem-solve. The two programmers switched roles frequently during the session (Zhong et al., 2017). With coding and PP new to the participants, the navigator concept of PP allowed for a reduction of the affective filter through shared student thinking. Participants worked together through difficult coding puzzles and offered alternative perspectives to solving the coding puzzles.

PP helped with student computational thinking, which involved solving problems and designing solutions using computer science (Wing, 2006). The National Research Council (2010) found computational thinking essential in the digital age with necessary 21st century competencies of creativity, critical thinking, and problem solving (Zhong et al., 2017). Through conceptualization, PP challenged students to explain themselves and make suggestions to one's partner. Furthermore, PP helped students to think ahead by anticipating potential problems with coding and debugging puzzles. This shared learning could possibly reduce content knowledge acquisition stress and lower the technology affective filter. Consequently, reduced stress increased student confidence with computer programming, which resulted in higher level programming completion and greater technological confidence. Within the final tier of technology affective filter digital divide framework (adapted from Hohlfield et al., 2008, Krashen, 1982, Delpit, 2006), students used acquired knowledge to design and create video game segment (ISTE Standard: NETS.S-4: Critical Thinking, Problem Solving, and Decision Making) (ISTE, 2016). Comprehensively, students developed a computer game segment through combined basic and complex computer skills development.

While participants did not initially know how to code a video game, the goal of the technology affective filter digital divide framework included routine technology skills development through keyboarding and coding modules to lower the affective filter (build technology confidence) which would enable participants to create their own video game segment. Through the digital literacy intervention, the intervention group participants developed persistence as a tool to lower the affective filter around skills development of coding and technology in a collaborative learning environment. Participants developed and shared coding strategies and empowered themselves with the knowledge to develop a video game segment through the completion of Code.org (n.d.) modules (ISTE Standard: NETS.S-6: Technology Operations and Concepts) (ISTE, 2016). Through continued high-level technology use and empowerment, the researcher designed this digital intervention to understand the relationship between computer testing confidence and student performance in third grade social studies and mathematics. The technology affective filter digital divide framework believed that the CBT-Confidence increase leads to lowering the affective filter barriers. In turn, the technology affective filter digital divide framework hypothesized that the digital literacy intervention would increase CBT-confidence as well as student performance on computer-based tests.

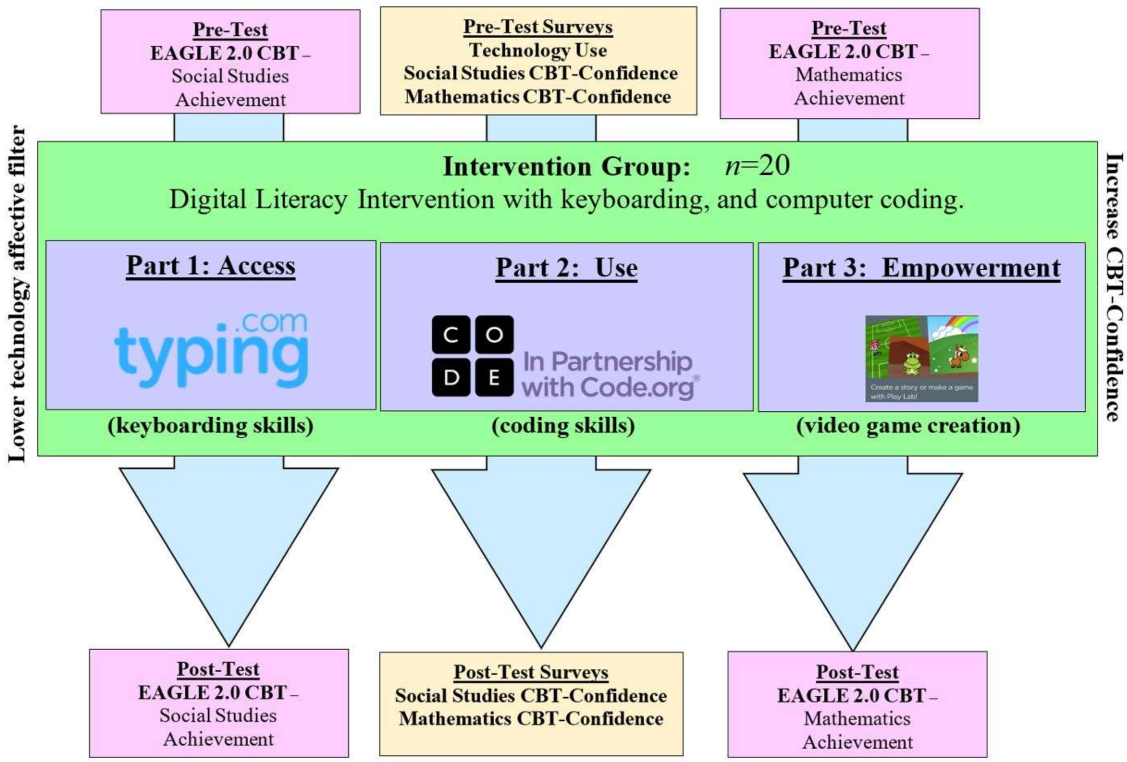



*Figure 4.* Conceptual Framework Design of Intervention

**Mock intervention for the control group.** The control participants knew about the research study involving some form of computer use. Therefore, a mock intervention was integrated into daily classroom instruction to display a class blog with daily classroom learning targets and objectives, assigned class-time informational reading and assigned homework. Furthermore, the mock intervention for the control group involved a specific class weblink to the interactive *Scholastic News – Grade 3* weekly magazine for use within the social studies/science instructional block. The control group received equal amount of time (30-minutes) with the mock intervention. The mock intervention involved some necessary third grade ICT skills: development of basic computer operation and using multimedia tools for research and information gathering (State of Louisiana Department of Education, 2016). Control group participants accessed the *Scholastic News – Grade 3* digital content, but they did not create a digital product.

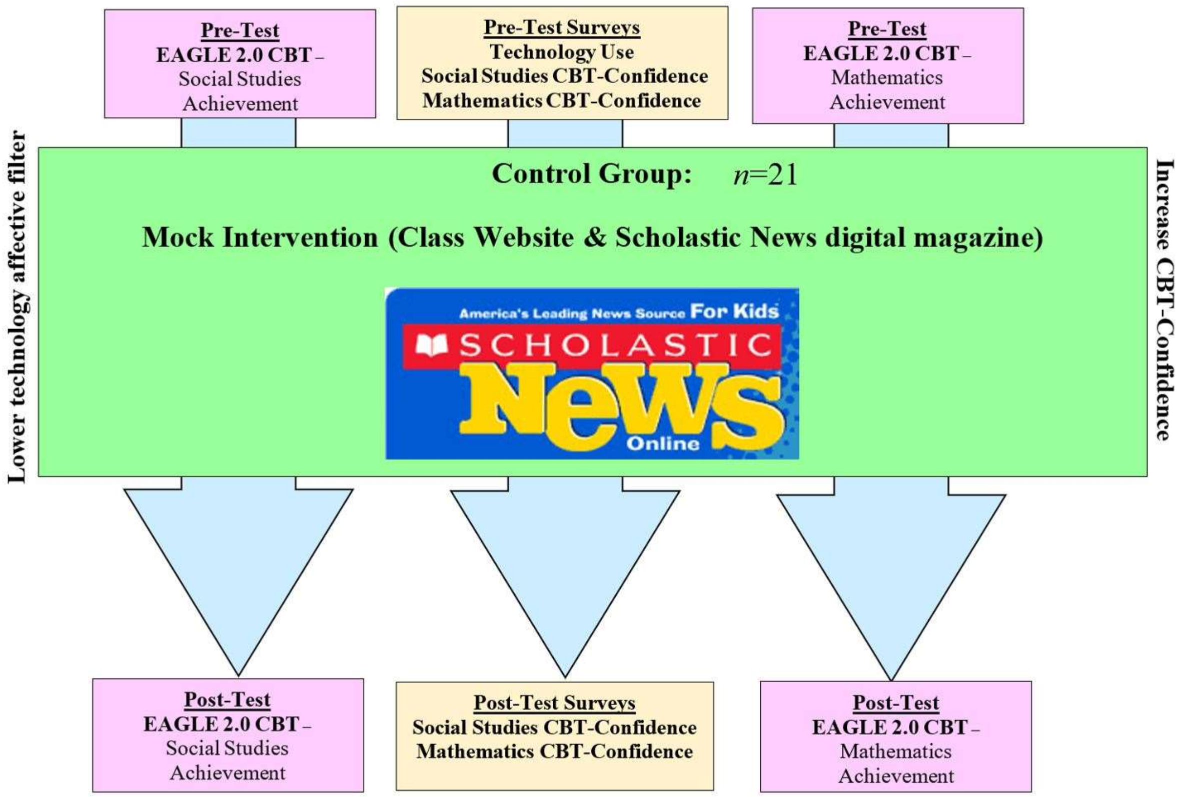



*Figure 5.* Conceptual Framework Design of Control

**Implementation of Interventions (Procedures)**

All third grade classroom cluster groups rotated between three teachers within the core content areas of English language arts, mathematics, science, and social studies. Core content subject areas include 90 instructional minutes. The digital literacy intervention happened during the last 30-minutes of the social studies/science instructional period. The scheduled research started at the beginning of the second semester of the academic school year, which also coincides with the beginning of the third quarter.

**Intervention schedule.** The intervention took place on Mondays, Wednesdays, and Fridays during the last 30 minutes of 90-minute science/social studies and enrichment blocks. The intervention group completed coding/keyboarding activities (Appendix D-E) while the control group received the mock intervention with reading digital issues of *Scholastic News – Grade 3* magazines during the 30-minute discovery learning station within the third grade science and social studies instructional block.

The following intervention timeline was used for both intervention and control groups:

Week 1: Pre-tests

On the first day, both participant groups completed the Technology-Use Baseline survey via the online class website. Then, both groups completed the EAGLE 2.0 CBT–Social Studies Grade 3 Pre-test and social studies CBT-confidence survey. Finally, both participant groups completed EAGLE 2.0 CBT–Mathematics Grade 3 Pretest and mathematics CBT-confidence survey.

Week 2:

The intervention group completed three Typing.com and two Code.org modules, including 32 puzzles: Programming in Maze–Part 1, Programming in Maze–Part 2, and Debugging in Maze with an introduction to pair programming (PP).

The control group read digital *Scholastic News – Grade 3*, “Robots to the Rescue.”

Week 3:

The intervention group completed three Typing.com and three Code.org modules using PP, including 33 puzzles: Debugging in Maze, Part 2, Programming in Collector, and Programming in Artist.

The control group read digital *Scholastic News – Grade 3*, “Going for the Gold.”

Week 4:

The intervention group completed three Typing.com and three Code.org modules, including 36 puzzles: Loops with Rey and BB-8, Loops in Artist, and Loops in Harvester.

The control group read digital *Scholastic News – Grade 3*, "A Hero at Home Plate."

Week 5:

The intervention group completed three Typing.com and two Code.org modules, including 22 puzzles: Build a Flappy Game, and Events in Play Lab.

The control group read digital *Scholastic News – Grade 3*, "Be Smart Online!"

Week 6: Post-tests

Both groups completed the EAGLE 2.0 CBT–Social Studies Grade 3 Post-test and social studies CBT-confidence survey. Finally, both participant groups completed EAGLE 2.0 CBT–Mathematics Grade 3 Post-test and mathematics CBT-confidence survey.

As students in the intervention group progressed through the initial Code.org (n.d.) modules, the initial stages of the digital intervention allowed participants to struggle without giving the answer to the puzzle. While already anticipating a high technology affective filter barrier due to the introduction of a new concept, constructivist early-childhood education pedagogies encouraged persistence through scaffolded learning and collaborative questioning strategies that allowed participants to arrive at a solution (Wilson, 1996, Zhong et al., 2017). Furthermore, pair programming allowed for students to discuss challenges and brainstorm solutions with peers. One suggestion for students needing additional support included coding in steps, such that the participant coded the puzzle line-by-line to see the result from each coded line.

In the control group, most participants readily accessed the digital magazine and read/listened to the digital articles. However, some participants struggled with logging on to the *Scholastic News – Grade 3* website with a simple class password that involved school name and year (combination of three lowercase characters and four numbers).

## Instrumentation

**Pretests and posttests.** EAGLE 2.0 served as an online testing portal established by the State of Louisiana Department of Education. Data Recognition Corporation (DRC) developed the Louisiana Education Assessment Program (LEAP) 2025 norm-referenced standardized test for the State Department of Education as a valid, reliable assessment tool measuring student performance on State Standards and Grade Level Expectations (GLEs). The EAGLE 2.0 testing portal provided educators access to criterion-based assessment questions that align to the state's standardized tests. With the State of Louisiana shifting state testing from paper-based testing (PBT) to computer-based testing (CBT), school districts have placed greater emphasis on EAGLE 2.0 testing portal for criterion-referenced test creation and state LEAP 360 benchmark assessments to measure student progress that aligns with and predicts performance on the high-stakes, norm-referenced LEAP 2025 standardized assessment.

In this research study, two EAGLE 2.0 computer-based assessments measured student performance on third grade social studies and mathematics content (DRC, 2017b, 2017a). The questions represented a subset of the district-created assessment for all Grade 3 students. Because one of the objectives of this research study involved measuring student computer-based testing confidence (CBT-confidence), the selection of previously taught and assessed third grade standards and GLEs factored into the creation of these two online EAGLE 2.0 assessments. The researcher included EAGLE 2.0 item sets of assessment questions from previous units so that participants would not have to struggle with new content in social studies and mathematics. Gningue, Peach and Schroder (2013) found higher student engagement of new learning when linked to prior knowledge allowing for greater application and use of skills in a different learning situation. Therefore, this research study could focus on technology skills development (new learning) in a learning cycle where prior knowledge is continually assessed with new learning.

The difference from pre-to-posttest served as the student performance in this research study. The following pretests and posttests were administered to all participants in the intervention and control groups via CBT format (see Appendices F-G).

**Social studies pretest and posttest: EAGLE 2.0 CBT–social studies grade 3 assessment (DRC, 2017b).** Third grade content standards and GLEs were used to identify a social studies task within the EAGLE 2.0 DRC social studies test database. Prior to the 2016–2017 school year, the State of Louisiana Department of Education field-tested the LEAP Social Studies assessment and shifted to a set-based design format that requires students to apply understanding of social studies with the formation of a claim. The LEAP 2025 Assessment Guide for Grade 3 Social Studies (State of Louisiana Dept. of Education, 2017d) identified the social studies task as "students use prior knowledge and source documents to develop their ideas and support their claims about social studies content and concepts" (p. 1).

The assessment design (Appendix F) consisted of four social studies source documents with a set of 11 multiple-choice questions. Assessment questions asked students to use prior content knowledge and the source documents to show an understanding of third grade social studies content. The first task included a constructed response that required the participants to use and cite information from digitally presented document sources to create a digital composition. Participants must use necessary technology skills to navigate through four documents, and use typing/keyboarding skills to compose, revise, and submit a composition demonstrating understanding map skills and knowledge of early Native American contributions to present day culture.

The specific content selected for this computer-based EAGLE 2.0 social studies assessment of 15 questions came from DRC database of prior social studies content. The assessment of previous unit material did not conflict with current student learning of new material. The CBT Grade 3 social studies assessment consisted of an item set with four sources on Native American tribes in Louisiana. The constructed response asked, "Describe how the early Native American tribes in Louisiana contributed to Louisiana's culture today" (DRC, 2017b, p. 7).

Students used technology skills to navigate the four digital sources, keyboarding skills and knowledge of social studies to create a digital composition answering the prompt. Subsequent technology-enhanced questions required students to sort artifacts on a digital chart based on sources and knowledge of social studies. The remainder of the EAGLE 2.0 assessment required students to complete the multiple-choice questions using knowledge of social studies.

**Mathematics pretest and posttest: EAGLE 2.0 CBT–mathematics grade 3 assessment (DRC, 2017a).** The researcher collaborated with the mathematics teacher to identify previously taught mathematics concepts and tasks within the EAGLE 2.0 DRC mathematics test database to develop an EAGLE 2.0 computer-based test that measured prior-content knowledge of Grade 3 content standards and GLEs. The specific content selected for this computer-based EAGLE 2.0 mathematics assessment of 15 questions (Appendix G) came from a prior mathematics unit on multiplication and foundational math skills of rounding, addition, and subtraction. The researcher designed the assessment with previous unit material so not to conflict with current student learning of new math content.

While 13 questions were multiple choice, the LEAP 2025 Assessment Guide for Grade 3 Mathematics (State of Louisiana Dept. of Education, 2017c) identified several technology-enhanced question types for computer-based testing. Considering that Multiple-select (MS) question sets have multiple correct answers, the student must be able to identify more than one correct answer. Question 3 required students to identify the two correct answers to the question, "Which two ways show how to find the value of 30 x 5?" Question 11 required students to identify three correct answers to the question, "Which three numbers round to 300 when rounding to the nearest hundreds place?" Students selected the two equations that can be used to solve 24 ÷ 6 = Δ in Question 15. The MS feature required participants to expand thinking beyond standard multiple-choice selection with a singular correct answer.

Another technology-enhanced question type included the short keyboard response, which required standard computer keyboarding skills to type the correct answer. Question 4 prompted students to "Solve the equation 954 – 786 = __" while Question 12 required students to "Enter the number that makes the equation true 6 x 80 = ___." Question 10 required students to use multiplication to solve the problem: "What is the total number of pieces of candy Cade has in his boxes?" This MS question types required students to conceptualize multiple correct answers and select various correct options.

**Technology-use baseline survey.** With most research predominately focused on secondary and higher-education technological competencies, research did not find an early-childhood Technology-Use survey suitable for this sample population. Therefore, researcher designed a Technology-Use survey to gather participant's access and technology use. The researcher informally field-tested this tool with English Language Learners (ELLs) in a self-contained classroom at ABC Elementary to ensure readability and kid-friendly terminology. Participants completed this online Technology-Use survey responding to the following question, "How do you use technology?" (See Appendix H).

**CBT-confidence survey.** A short online questionnaire (see Appendix I) included the question, "How do you feel about taking the test on the computer?". This survey was applied to both social studies and mathematics, separated. Participants responded (1–5) on a Likert scale representing the following performance levels: not so good, just enough to pass, average, above average and distinguished.

Common Core State Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010a) and Partnership for Assessment of Readiness for College and Careers (PARCC, 2015) defined these performance-level descriptions as confidence levels indicating an estimation of entry-level success: minimal, partial, moderate, strong, and distinguished (PARCC, 2015).

## Variables

This research study comprised three components: one set of variables measuring student performance in content areas of social studies and mathematics, another set of variables measuring the technology affective filter (confidence) with computer-based testing, (CBT-confidence) (see conceptual framework design in Figures 3 & 4), and an additional set of variables to explain differences between intervention and control groups.

**Student Performance variables.** The two EAGLE 2.0 assessments of student performance in social studies and mathematics served as the pretest and posttest to measure the total correct answers (score) in social studies and mathematics. The research study included two pretest scores, one for social studies (SSPRE) and other in mathematics (MATHPRE), and the respective posttest for social studies (SSPOST) and mathematics (MATHPOST). The EAGLE 2.0 assessment questions originated from Data Recognition Corporation (DRC), which also creates state-standardized assessments for the State of Louisiana Department of Education. These pretest and posttest measures included the following variables:

***Social studies pre–posttest [SSPRE] and [SSPOST].*** Pre–posttest social studies score: Integer value range from 0 to 15. Pre–post scores are calculated as sum (∑) of correct answers with each question assigned a value: correct = 1, and incorrect= 0. Missing answers were scored as wrong.

***Mathematics pre–posttest [MATHPRE] and [MATHPOST].*** Pre–post-test mathematics score: Integer range from 0 to 15. Pre–post scores are calculated as sum (∑) of correct answers with each question assigned value: correct = 1, and incorrect = 0. Missing answers were scored as wrong.

***Change in student performance [ΔSS] and [ΔM].*** Change in student performance measured differences (increase or decrease) between pretests and posttests in social studies and mathematics.

Δ**SS** = SSPOST <minus> SSPRE

Δ**MATH** = MATHPOST <minus> MATHPRE

The change in student performance score for social studies and mathematics (Δ**SS** and Δ**MATH**) was the difference between pre and post scores. The Δ**SS** and Δ**MATH** scores ranged from negative 15 to score of 15. A score of 0 meant no change from pre to post test. A negative score meant that the participant had fewer questions correct on the posttest. A positive score meant that the participant had more correct answers on the posttest.

**CBT-confidence variables.** Participants self-reported their confidence taking the computer-based test at the end of each social studies and mathematics pretest and posttest. The following six CBT-confidence variables were included in this research study:

***Social studies CBT-confidence [SSPreConf] and [SSPostConf].*** Pre–post participant-reported CBT-confidence score after completing social studies computer-based test. Integer values ranged from 1 to 5.

***Mathematics CBT-confidence [MPreConf] and [MPostConf].*** Pre–post participant-reported CBT-confidence score after completing mathematics computer-based test. Integer values ranged from 1 to 5.

***Change in CBT-confidence [ΔSSConf] and [ΔMconf].*** The effects of the affective filter were measured via the change in participant's CBT-confidence within the specified content areas of social studies and mathematics. This value was calculated from the difference from pretest to posttest of CBT-confidence survey. The CBT-confidence change was reported, separately, for social studies and mathematics:

Δ**SSConfidence** = SSPostConf <minus> SSPreConf

Change in social studies CBT-confidence (Δ**SSConf**) was the difference between pre-post CBT-Confidence scores in social studies.

Δ**MConfidence** = MPostConf <minus> MPreConf

Change in mathematics CBT-Confidence (Δ**MConf**) was the difference between pre-post CBT-confidence scores in mathematics.

Both the Δ**SSConfidence** and Δ**MConfidence** scores ranged from negative 5 to score of 5. A score of 0 meant no change. A negative score meant a decrease in CBT-confidence from pre to posttest. A positive score meant an increase in CBT-confidence from pre to posttest.

**Intervention variables.** The following variables measured the effectiveness of the coding component of the digital literacy intervention. These variables did not apply to the control group because the control group did not receive the digital literacy intervention. The research study focused on the coding components of the digital literacy intervention because the intervention variables [Lined Coded] and [CompletedLevels] provided the only valid and reliable assessment of the digital literacy intervention.

***Lines Coded [LinesCoded].*** This variable measured the number of programming lines coded through the various coding modules in the digital literacy intervention. This intervention variable started at 0 and ended at the highest integer number of lines correctly coded throughout the Code.org (n.d.) modules. The Code.org (n.d.) modules in this digital literacy intervention included 123 online puzzles. The participant used digital coded blocks to solve the module computer game situation. While students collaboratively work in PP, the students have the same number of lines coded, regardless of their individual contributions to the exercises.

The Code.org (n.d.) modules scaffolded coding skills through gradual skills development. Once participants coded the number of lines for successful completion of the level, they advanced to the next level. The basic number of lines to complete the level depended on the complexity of the puzzle. However, the Code.org puzzles allowed for individual creativity with participants creating advanced scenarios using the same coding blocks within the existing module. In turn, the participant could write more lines of code within the same level. The number of lines coded reflects participants understanding of coding throughout the Code.org modules.

***Coding levels completed [CompletedLevels].*** This variable measured the number of completed coding levels throughout the digital literacy intervention. The participants completed online puzzles within the various modules of the assigned Course C curriculum (Code.org, n.d.). Each online puzzle constituted a level. Each module included 10–12 levels and an embedded video module introduction–overview. There are 123 levels within the digital literacy intervention. Each participant received credit for the level by successfully completing the online puzzle (individually or when working in pairs). While students collaboratively work in PP, the students have the same number of lines coded, regardless of their individual contributions to the exercises.

The following ancillary variable also helped explain differences between intervention and control groups.

**Technology-Use Variable [TechUse].** The Technology-Use variable (TechUse) was collected from participants completing an online technology use questionnaire (Appendix H) to establish a baseline of participant's access and use of technology beyond the classroom environment. The Technology-Use score ranged from 0 and 13 where each affirmative answer was scored as 1 and each negative answer scored as 0. Each question also had open space for participants to explain how they use the specific technology or category. While not factored into the Technology-Use score, this qualitative data was used to verify participants' responses regarding technology uses.

The following ancillary variable served in identification and categorization of data.

**Participant identification number [PID].** This variable identified participants with a 4-digit code. The first digit corresponded to the class assignment either *I* for intervention group or *C* for control group at ABC Elementary School. The remaining 3-digit student ID number consisted of a connective number assigned randomly to each participant within that specific group (e.g., Intervention group: Student #I001, Control group: Student #C001). This variable allowed the researcher to match participants' pre and post assessment data and provide greater anonymity with sensitive student assessment information.

## Reliability and Validity of Instrumentation and Procedures

### Research Design.

To address internal reliability of the research procedures, the researcher designed quasi-double-blind (pretest and posttest) action plans for the intervention and control groups. The teacher-researcher conducting this research study acknowledges a bias threat to internal validity of this research study. To address for bias, the teacher-researcher involved an outside person to randomly assign intervention and control groups. The intervention group participated in a digital literacy intervention with coding modules from Code.org (n.d.) and keyboarding modules from Typing.com (n.d.).

Typing.com did not provide reliable assessment of typing skills because the researcher could not guarantee that participants would receive the same typing pretest and posttest assessment. A participant could potentially self-select a "timed test" in lieu of a keyboarding module. The researcher used Typing.com due to exclusive digital privacy agreement with the school district. With the uniformity of identical pretest and posttest assessments, the researcher chose to forgo Typing.com data due to lack of reliable assessment and reporting measures. The game creation component of the digital literacy intervention required a rubric which would involves subjective assessment. Therefore, the coding components of the intervention variables [Lined Coded] and [CompletedLevels] provided the only valid and reliable assessment of the digital literacy intervention.

The control group participated in a mock intervention being the reading of digital issues of *Scholastic News – Grade 3*. To prevent tester contamination effects through implementation of the research study, all students in both groups completed the online social studies and mathematics pre and post-tests via EAGLE 2.0 and the Technology-Use Baseline and CBT-confidence pre and post-tests via Survey Monkey. To control for threats to internal validity, an upper grade teacher randomly selected which cluster group received the intervention and the control.

While the mock intervention served as passive technology use with routine access to reading digital magazine content in social studies, it might have sparked interest in computers among participants in the control group. Although repetitive access to online content and passive technology consumption may influence the control group, access to digital instruments (i.e. pretests and posttests, online surveys and technology baseline surveys) are low-level technology use activities within many marginalized communities. The digital literacy intervention involved a higher-level use of technology with the development of coding skills to create a video game segment. Margolis et al. (2008) extended that "real [digital] access involves communication, production and design with technology" (p.3).

**EAGLE 2.0 computer-based tests (CBT) in social studies and mathematics.** These CBT instruments were already validated by State of Louisiana Department of Education. The LEAP 2025 assessment development educator review committee made up of 8-10 educators representing diverse demographics of the state develop and field test questions within diverse classroom across the state. The item content and bias review committee provided feedback regarding potential bias and sensitivity issues and makes recommendations to accept or reject field-tested items (State of Louisiana Department of Education, 2018). To control for threats to internal validity, the researcher administered the CBT to all students in each group (intervention and control) at the same time to avoid design contamination. As with CBT protocol, the researcher generated individual student CBT tickets with unique usernames and secure passwords. The usernames and passwords included 7-10 characters with upper/lowercase letters and numbers requiring careful attention to detail to gain access to the secure EAGLE 2.0 test site.

The subset of questions selected for the pre–post assessment in this research study involved previously taught academic content. Students completed the pretests and posttests as benchmark assessments measuring previously taught content and skills. Just as standardized tests assess mastery of previously learned content, these pretest and posttest assessments measured content standards addressed prior to the beginning of this research study to ensure unbiased assessment of previously learned content and not current content instruction.

**Data Collection Procedures**

Collection of data included pre and post tests given to the targeted population (intervention and control group). The researcher developed a website page with links to administer the online Technology-Use Baseline and the CBT-confidence surveys to both groups during the pre-test administration in the first week and the post-test in the last week of the research study. The website page also included links for intervention group participants to access the specific modules administered during the digital literacy intervention. Prior to the collection of data, the researcher created an excel master data spreadsheet with Participant ID (PID) numbers as key for pairing up student performance data from EAGLE and Code.org.

Participants entered their Participant ID (PID) number when completing Technology-Use Baseline and CBT-confidence surveys.

**Collecting Student Performance Data.** During the first and last weeks of the research study, participants in both intervention and control groups completed pretest and posttest assessments in social studies and mathematics. As per state and district computer-based testing (CBT) protocol, students were issued a single ticket with specific login and unique password for the assigned test. Participants used an assigned computer to log onto the EAGLE 2.0 portal for the assigned assessment. While scheduled to last approximately 20-30 minutes, participants in both groups averaged approximately 10-15 minutes on each pre-test and approximately 15-30 minutes on each post-test.

EAGLE 2.0 graded the Social studies and mathematics pre and post-tests. The pretest and posttest results were exported to an excel data sheet, paired with assigned Participant ID (PID) number, and student names were deleted to maintain student anonymity.

**Collecting Technology-Use Baseline and CBT-Confidence Data.** Participants completed Technology-Use and CBT-confidence surveys via survey monkey link on the class website. Participants typically completed the Technology-Use Baseline survey approximately 7-11 minutes while participants completed the CBT-confidence survey in approximately 1-3 minutes each. Students provided Participant ID (PID) number when completing these surveys. The survey monkey data was exported to an excel data sheet. The data was cross-checked with PID and the researcher manually-copied the data into the master excel spreadsheet. Once entered into the spreadsheet, student names were deleted to maintain student anonymity.

**Collecting Intervention Data.** At the end of the research study, intervention data was compiled from a usage report. The report included student's name, number of lines coded

[LinesCoded] and number of completed levels [LevelsCompleted]. When students collaboratively worked in PP, students logged on identifying the PP partner, the students received credit for the same number of lines coded. The Code.org data was matched with assigned Participant ID (PID) number, and manually-copied into master data excel spreadsheet. Once entered into the spreadsheet, student names were deleted to maintain student anonymity.

There were no problems with computers or accessing the website or EAGLE 2.0 portal. However, problems arose with students not remembering their assigned PID number. The researcher had one printout as the key to match name with PID for exporting student data from EAGLE 2.0 or Code.org. The researcher provided participants with a written PID number. At the end of the research study, the printout to match data was destroyed.

**Data Analysis Procedures**

Descriptive statistics were compiled with means, range, and standard deviation analyzed to verify the quality of the data. With unequal groups (intervention group ($n$=20) and control group ($n$=21)), the researcher ruled out paired t-test analysis, however, the researcher still analyzed changes in pre-to-post scores in social studies and mathematics. Considering that the researcher used the scores of total correct answers to measure changes from pretest to posttest, the researcher chose not to complete analysis for each question independently. Linear regression analysis was run to determine relationships between social studies and mathematics scores, CBT-confidence, and technology use. Furthermore, the researcher conducted a separate analysis with the intervention group to determine the relationship between change in CBT-confidence (ΔSSConf and ΔMConf), Technology-Use (TechUse), and the intervention variables of Lines Coded and Completed Levels.

Furthermore, the researcher completed an analysis of variance (ANOVA) to determine if any significant relationships existed between change in student performance, change in CBT-confidence, and Technology-Use scores among all participants (intervention and control groups). The researcher also completed a separate ANOVA with the intervention group to determine if the intervention variables of Lines Coded and Completed Levels had any significant effect on change in CBT-confidence in social studies and mathematics.

The researcher used linear regression analysis to find the correlation coefficient, *r*, and to determine if the digital intervention explained the variance in the student performance and CBT-confidence scores. Student performance served as the dependent variable, while the number of lines coded served as the independent variable. The researcher hypothesized that the digital literacy intervention would affect CBT-confidence and student performance in third grade social studies and mathematics. Furthermore, the researcher also used an ANOVA to find significant differences and test this hypothesis. The covariance between the two measures was correlated and significance tests conducted, taking this correlation into effect. Utilizing ANOVA benefited this quasi-experimental research study because the researcher investigated the relationship between CBT-confidence and student performance in a single experiment.

# CHAPTER FOUR

# RESULTS

## Overview

This quasi-experimental quantitative research study focused on answering the following research questions:

Q1. What is the relationship between third grade computer-based testing (CBT) confidence and student performance in social studies and mathematics?

Q2. What is the relationship between coding levels completed and lines coded on the CBT-confidence in social studies and mathematics of the intervention group?

This chapter provides the following findings: the results from technology baseline survey, the results relating to the relationship between CBT-confidence and performance among both participant groups, and the results describing the relationship between intervention variables, Technology-Use, and CBT-confidence. Finally, the chapter closes with a summary of the results for discussion in the following chapter.

## Description of Sample Population

The actual sample represented in this research study consisted of 41 third grade students ($n$=41) within two classrooms, or cluster groups, at ABC Elementary. While serving in a role as teacher at ABC Elementary, the researcher accessed school data to gather gender and ethnicity information compliant with maintaining security of personally-identifiable information (PII) and protecting student data and privacy rights. The intervention group ($n$=20) consisted of 20 students with 55% male and 45% females comprising 75% African American, 20% Hispanic, and 5% Other ethnicities. The control group ($n$=21) consisted of 21 students with 67% male and 33% female comprising 71% African American, 14% Hispanic, 5% Caucasian, and 10% Other ethnicities. While serving in the role as teacher at ABC Elementary, the researcher did not coerce students to participate in the study. The research study included 100% voluntary participation and 100% retention of participants in both intervention and control groups for the six-week duration of the research study. A high-poverty school, all participants in both groups qualified for free/reduced lunch.

Table 1

*Demographics of Sample Population*

| | Intervention (*n* =20) | | Control (*n* =21) | | Total (*n* =41) | |
|---|---|---|---|---|---|---|
| **Gender** | *n* | % | *n* | % | *n* | % |
| Male | 11 | 55 | 14 | 67 | 25 | 61 |
| Female | 9 | 45 | 7 | 33 | 16 | 39 |
| **Ethnicity** | *n* | % | *n* | % | *n* | % |
| African American | 15 | 75 | 15 | 71 | 30 | 73 |
| Hispanic | 4 | 20 | 3 | 14 | 7 | 17 |
| Caucasian | 0 | 0 | 1 | 5 | 1 | 3 |
| Other | 1 | 5 | 2 | 10 | 3 | 7 |
| **Socioeconomics** | *n* | % | *n* | % | *n* | % |
| Free/Reduced Lunch | 20 | 100 | 21 | 100 | 41 | 100 |

## Technology-Use Baseline

Results from the Technology-Use Baseline survey administered at the beginning of the research study to the targeted population of students at ABC Elementary reported that 55% of intervention group and 62% of control group as having a computer at home (Table 2). Furthermore, 35% of intervention group and 43% of control group indicated that the computer at home has internet. Similarly, 60% of the intervention group and 52% of the control group conveyed using a smartphone. Importantly, 70% of intervention group and 76% of control group also identified use of video game systems.

While both participant groups reported using technology to watch videos (68%), 50% of intervention group and 86% of control group reported watching videos. Furthermore, 66% of both groups used technology to play online games (66%). Forty-five percent of the intervention group, while 86% of the control group, used technology to play online games. These results provided evidence that the video game system served as primary technology used by both participant groups. This technology use result aligned with the technology skills development in the coding element of the digital literacy intervention.

The average Technology-Use Baseline score for both groups was 5.5 (SD=2.829, range 1 to 13, Table 3). The mean score for the intervention group was 4.6 (SD=2.817, range 1 to 13, Table 4) and 6.3 points for the control group (SD=2.468, range 2 to 11, Table 5). These results provided evidence that the intervention group used less technology at home. Interestingly, the control group had higher overall technology use while the intervention group only showed higher technology use percentages in "searching the internet" and "having a smartphone" (Table 2). Furthermore, these results also indicate a technology use disparity between the intervention and control groups resembling an actual digital divide within the sample population.

Table 2

*Descriptive Data from Technology-Use Baseline Survey*

| | Intervention (*n* =20) | | Control (*n* =21) | | Total (*n* =41) | |
|---|---|---|---|---|---|---|
| Question | *n* | % | *n* | % | *n* | % |
| Computer at home | 11 | 55 | 13 | 62 | 24 | 56 |
| Computer Connected to Internet | 7 | 35 | 9 | 43 | 16 | 39 |
| Use: Search internet | 7 | 35 | 5 | 24 | 12 | 29 |
| Use: Listen to music | 8 | 40 | 13 | 62 | 21 | 51 |
| Use: Send email | 2 | 10 | 5 | 24 | 7 | 17 |
| Use: Social media | 1 | 5 | 5 | 24 | 6 | 15 |
| Use: Watch videos | 10 | 50 | 18 | 86 | 28 | 68 |
| Use: Play Online game | 9 | 45 | 18 | 86 | 27 | 66 |
| Use: Communicate | 2 | 10 | 4 | 19 | 6 | 15 |
| Use: Other | 2 | 10 | 4 | 19 | 6 | 15 |
| Have: Smartphone | 12 | 60 | 11 | 52 | 23 | 56 |
| Have: Tablet | 13 | 65 | 14 | 67 | 27 | 66 |
| Have: Video Game System | 14 | 70 | 16 | 76 | 30 | 73 |
| **Mean TechUse Score** | **4.6** | | **6.3** | | **5.5** | |

## Statistical Analysis: Research Question #1

The research study investigated the following overarching research question: "What is the relationship between third grade computer-based testing (CBT) confidence and student performance in social studies and mathematics?"

**Overall Social Studies CBT-Confidence among Both Participant Groups.** The average change in social studies CBT-confidence score [ΔSSconf] for both groups was 0.46 (SD=1.227, range -2 to 3, Table 3). The average change in social studies CBT-confidence score for the intervention group (M=1.3, SD=.979, Table 4) was higher than the control group (M=-0.33, SD=0.856, Table 5). Interesting, while the intervention group social studies CBT-confidence pretest mean score was 1.70 (SD=.571, Table 4), the control group had a higher mean of 2.81 (SD=.981, Table 5). However, the posttest social studies CBT-confidence mean for intervention group (M=3.00, SD=.918, Table 4) was higher than the control group (M=2.5, SD=1.209, Table 5). These results showed that overall mean of social studies CBT-confidence scores (ΔSSConf) for both groups increased as result of the interventions. Furthermore, the intervention group showed a high increase in social studies CBT-confidence (from 1.7 to 3.0, Table 4) while the control group decreased (from 2.8 to 2.4, Table 5).

**Overall Mathematics CBT-Confidence among Both Participant Groups.** The average change in mathematics CBT-confidence scores [ΔMconf] for both groups was negative (M=-0.15, SD=0.727, range -2 to 1, Table 3). However, the change in mathematics CBT-confidence scores for the intervention group (M= 0.1, SD=.447, Table 4) was higher than in the control group (M= -0.38, SD=.865, Table 5). The intervention group mathematics pretest CBT-confidence mean score was 3.0 (SD=0.918. Table 4) while for the control group was 2.9 (SD=1.179, Table 5). The posttest CBT-confidence mean score was 3.1 for the intervention group (Table 4) and for the control group was 2.5 (Table 5).

These results indicated that overall mean of math CBT-confidence scores (ΔMConf) decreased as result of the interventions. The intervention group showed a slight increase in mathematics CBT-confidence (from 3.0 to 3.1, Table 4) while the control group decreased (from 2.9 to 2.5, Table 5). These results do not show a significant impact of digital literacy intervention on the CBT-confidence of both participant groups.

**Overall Social Studies Performance among Both Participant Groups.** The average change in social studies performance scores [ΔSS] for both groups was 2.15 (SD= 3.511, range -5 to 10, Table 3). The average change in social studies performance scores for the intervention group (M=4.1, SD=3.493, Table 4) was higher than in the control group (M= 0.29, SD=2.369, Table 5). The intervention group social studies performance pretest mean score was 4.40 (SD=1.698, Table 4) while the control group had a mean of 4.24 (SD=2.663, Table 5). The mean posttest social studies performance score for intervention group was 8.50 (SD=3.818, Table 4) while the control group averaged 4.52 (SD=1.806, Table 5).

These results showed that overall mean change in social studies performance scores (ΔSS) for both groups increased as result of the interventions. The intervention group also showed a high increase change in social studies performance (from 4.40 to 8.50, Table 4) while the control group marginally increased (from 4.24 to 4.52, Table 5).

**Overall Mathematics Performance among Both Participant Groups.** The average change in mathematics performance score [ΔMATH] for both groups was 1.71 (SD=2.657, range -5 to 8, Table 3). The average change in mathematics performance scores for the intervention group (M=2.55, SD=2.481, Table 4) was higher than in the control group (M= 0.90, SD=2.625, Table 5). The intervention group mathematics performance score pretest mean score was 3.40 (SD=2.583, Table 4) while the control group had a higher mean of 3.86 (SD=2.476, Table 5). The mean posttest mathematics performance score for intervention group was 5.95 (SD=3.268, Table 4) while the control group averaged 4.76 (SD=2.998, Table 5).

These results showed that overall mean change in mathematics performance scores (ΔMATH) for both groups increased as result of the interventions (M=2.55 for intervention group, M=0.90 for control group, Tables 4 and 5). Furthermore, the intervention group and control group showed an increase in mathematics performance scores, while intervention group increased from 3.40 to 5.95 (Table 4), the control group increased from 3.86 to 4.76 (Table 5).

Table 3
*Descriptive Statistics for Both Participant Groups (n=41)*

| Score | *N* | Range | Minimum | Maximum | Mean | Std. error | Std. deviation | Variance |
|---|---|---|---|---|---|---|---|---|
| **ΔSS** | **41** | **15** | **-5** | **10** | **2.15** | **0.548** | **3.511** | **12.328** |
| SSPRESCORE | 41 | 9 | 0 | 9 | 4.32 | 0.346 | 2.219 | 4.922 |
| SSPOSTSCORE | 41 | 15 | 0 | 15 | 6.46 | 0.554 | 3.550 | 12.605 |
| **ΔSSConf** | **41** | **5** | **-2** | **3** | **0.46** | **0.192** | **1.227** | **1.505** |
| SSPreConf | 41 | 3 | 1 | 4 | 2.27 | 0.152 | 0.975 | 0.951 |
| SSPostConf | 41 | 4 | 1 | 5 | 2.73 | 0.171 | 1.096 | 1.201 |
| **ΔMATH** | **41** | **13** | **-5** | **8** | **1.71** | **0.415** | **2.657** | **7.062** |
| MATHPRESCORE | 41 | 9 | 0 | 9 | 3.63 | 0.392 | 2.508 | 6.288 |
| MATHPOSTSCORE | 41 | 14 | 0 | 14 | 5.34 | 0.492 | 3.151 | 9.930 |
| **ΔMconf** | **41** | **3** | **-2** | **1** | **-0.15** | **0.113** | **0.727** | **0.528** |
| MPreConf | 41 | 4 | 1 | 5 | 2.95 | 0.164 | 1.048 | 1.098 |
| MPostConf | 41 | 4 | 1 | 5 | 2.80 | 0.172 | 1.100 | 1.211 |
| **TECHUSE** | **41** | **10** | **1** | **11** | **5.46** | **0.442** | **2.829** | **8.005** |

Table 4
*Descriptive Statistics for Intervention Group (n=20)*

| Score | *N* | Range | Minimum | Maximum | Mean | Std. error | Std. deviation | Variance |
|---|---|---|---|---|---|---|---|---|
| CompletedLevels | 20 | 58 | 53 | 111 | 81.60 | 4.319 | 19.316 | 373.095 |
| LinesCoded | 20 | 1361 | 378 | 1739 | 933.85 | 88.837 | 397.290 | 157839.082 |
| **ΔSS** | **20** | **15** | **-5** | **10** | **4.10** | **0.781** | **3.493** | **12.200** |
| SSPRESCORE | 20 | 7 | 0 | 7 | 4.40 | 0.380 | 1.698 | 2.884 |
| SSPOSTSCORE | 20 | 15 | 0 | 15 | 8.50 | 0.854 | 3.818 | 14.579 |
| **ΔSSConf** | **20** | **4** | **-1** | **3** | **1.30** | **0.219** | **0.979** | **0.958** |
| SSPreConf | 20 | 2 | 1 | 3 | 1.70 | 0.128 | 0.571 | 0.326 |
| SSPostConf | 20 | 4 | 1 | 5 | 3.00 | 0.205 | 0.918 | 0.842 |
| **ΔMATH** | **20** | **11** | **-3** | **8** | **2.55** | **0.555** | **2.481** | **6.155** |
| MATHPRESCORE | 20 | 8 | 1 | 9 | 3.40 | 0.578 | 2.583 | 6.674 |
| MATHPOSTSCORE | 20 | 13 | 1 | 14 | 5.95 | 0.731 | 3.268 | 10.682 |
| **ΔMconf** | **20** | **2** | **-1** | **1** | **0.10** | **0.100** | **0.447** | **0.200** |
| MPreConf | 20 | 4 | 1 | 5 | 3.00 | 0.205 | 0.918 | 0.842 |
| MPostConf | 20 | 3 | 2 | 5 | 3.10 | 0.204 | 0.912 | 0.832 |
| **TECHUSE** | **20** | **10** | **1** | **11** | **4.60** | **0.630** | **2.817** | **7.937** |

Table 5
*Descriptive Statistics for Control Group (n=21)*

| Score | *N* | Range | Minimum | Maximum | Mean | Std. error | Std. deviation | Variance |
|---|---|---|---|---|---|---|---|---|
| **ΔSS** | **21** | **8** | **-4** | **4** | **.29** | **0.517** | **2.369** | **5.614** |
| SSPRESCORE | 21 | 9 | 0 | 9 | 4.24 | 0.581 | 2.663 | 7.090 |
| SSPOSTSCORE | 21 | 7 | 2 | 9 | 4.52 | 0.394 | 1.806 | 3.262 |
| **ΔSSConf** | **21** | **3** | **-2** | **1** | **-0.33** | **0.187** | **0.856** | **0.733** |
| SSPreConf | 21 | 3 | 1 | 4 | 2.81 | 0.214 | 0.981 | 0.962 |
| SSPostConf | 21 | 4 | 1 | 5 | 2.48 | 0.264 | 1.209 | 1.462 |
| **ΔMATH** | **21** | **11** | **-5** | **6** | **0.90** | **0.573** | **2.625** | **6.890** |
| MATHPRESCORE | 21 | 9 | 0 | 9 | 3.86 | 0.540 | 2.476 | 6.129 |
| MATHPOSTSCORE | 21 | 11 | 0 | 11 | 4.76 | 0.654 | 2.998 | 8.990 |
| **ΔMconf** | **21** | **3** | **-2** | **1** | **-0.38** | **0.189** | **0.865** | **0.748** |
| MPreConf | 21 | 4 | 1 | 5 | 2.90 | 0.257 | 1.179 | 1.390 |
| MPostConf | 21 | 4 | 1 | 5 | 2.52 | 0.264 | 1.209 | 1.462 |
| **TECHUSE** | **21** | **9** | **2** | **11** | **6.29** | **0.578** | **2.648** | **7.014** |

### Regression Analysis among Both Participant Groups

**Social Studies Performance and Social Studies CBT-Confidence.** ANOVA and linear regression analyses were conducted to determine if a significant relationship existed between change in social studies performance [ΔSS], change in social studies CBT-confidence [ΔSSConf], social studies pre and post test scores [SSPRE and SSPOST], and Technology-Use Baseline [TechUse]. As result, Technology-Use Baseline and social studies pretest and posttest scores were excluded through stepwise regression analysis. A significant regression equation between ΔSS and ΔSSConf: ($F(1,40) = 19.884$, $p<.001$), explained 33.2% of the variance (Tables 6,7), meaning that there are other variables, not considered in this study that should also explain the differences.

Table 6

*Regression Model: Change in Social Studies Performance & CBT-Confidence (n=41)*

| Model | R | $R^{2\,b}$ | Adjusted $R^2$ | Std. error of the estimate |
|---|---|---|---|---|
| 1 | .576[a] | 0.332 | 0.315 | 1.073 |

*Note*. [a] Predictors: ΔSS. [b] For regression through the origin (the no-intercept model), $R^2$ measures the proportion of the variability in the dependent variable about the origin explained by regression. This cannot be compared to $R^2$ for models which include an intercept.

Table 7

*ANOVA Results: Change in Social Studies Performance and CBT-Confidence (n=41)* [a, b]

| Model | | Sum of squares | *df* | Mean square | *F* | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 22.911 | 1 | 22.911 | 19.884 | .000[c] |
| | Residual | 46.089 | 40 | 1.152 | | |
| | Total | 69.000[d] | 41 | | | |

*Note*. [a]ΔSSConf. [b]Linear regression through the origin. [c]Predictors: ΔSS. [d]This total sum of squares is not corrected for the constant because the constant is zero for regression through the origin.

**Mathematics Performance and Mathematics CBT-Confidence.** ANOVA and linear regression analyses were conducted to determine if a significant relationship exists between change in mathematics performance [ΔMath], mathematics CBT-confidence [ΔMConf], mathematics pre and post-tests scores [MATHPRE and MATHPOST], and Technology-Use Baseline [TechUse]. Results indicated no overall significance between change in mathematics performance and mathematics CBT-confidence (R=0.06, Table 8) (F(3,38)=0.865, $p$=.467, Table 9).

Table 8

*Regression Model: Change in Math Performance and CBT-Confidence (n=41)*

| Model | *R* | $R^{2\,b}$ | Adjusted $R^2$ | Std. error of the estimate |
|---|---|---|---|---|
| 1 | .253[a] | 0.064 | -0.010 | 0.736 |

*Note*. [a]Predictors: MATHPOSTSCORE, TECHUSE, ΔMATH. [b]For regression through the origin (the no-intercept model), $R^2$ measures the proportion of the variability in the dependent variable about the origin explained by regression. This cannot be compared to $R^2$ for models which include an intercept.

Table 9
*ANOVA: Change in Mathematics Performance and CBT-Confidence (n=41)* [a, b]

| Model | | Sum of squares | *df* | Mean square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 1.407 | 3 | 0.469 | 0.865 | .467[c] |
| | Residual | 20.593 | 38 | 0.542 | | |
| | Total | 22.000[d] | 41 | | | |

*Note*. [a]ΔMConf. [b]Linear regression through the origin. [c]Predictors: MATHPOSTSCORE, TECHUSE, ΔMATH. [d]This total sum of squares is not corrected for the constant because the constant is zero for regression through the origin.

**Statistical Analysis: Research Question #2**

The research study investigated the following secondary research question: "What is the relationship between coding levels completed and lines coded on the CBT-confidence in social studies and mathematics of the intervention group?" The intervention group only received the digital literacy intervention. The digital literacy intervention provided routine access and technology skills development to lower the affective filter by increasing confidence. Therefore, the impact of the digital literacy intervention on CBT-confidence implied similar impact on student performance.

The analysis conducted included two variables that only apply to the intervention group:

**Completed Levels [CompletedLevels].** The average number of completed levels in the intervention group was 81.60 (range 53 to 111, SD=19.316, Table 4). This result showed that participants in the intervention group completed from 53 to 111 of the total 123 levels within the Code.org – Course C curriculum.

**Lines Coded [LinesCoded].** The average number of lines coded by intervention group participants was 933.85 (range 378 to 1739, SD=397.290, Table 4). This result showed a wide range of number of lines coded during the intervention (range=1361, Table 4).

The results presented intervention group participants progress through the digital literacy intervention in terms of coding task completion [CompletedLevels] and overall coding progress [LinesCoded]. These measures indicated technological skills development through the digital literacy intervention with the goal of reducing the affective filter with technology and increasing confidence.

**Regression Analysis with intervention group**

**Social Studies CBT-Confidence with Intervention Group.** Stepwise linear regression and ANOVA analyses were conducted to determine the relationship significance between change in social studies CBT-confidence [ΔSSConf], Technology-Use Baseline [TechUse], and the intervention variables [CompletedLevels and LinesCoded]. The stepwise regression produced three significant models (Table 10). ANOVA results showed that all three regression models demonstrated significant relationships between the intervention variables (completed levels, lines coded), technology use [TECHUSE] and change in social studies CBT-confidence [ΔSSconf]. While model 1 only included LevelsCompleted, module 2 included also LinesCoded, and model 3 also included TECHUSE.

Table 10
*Regression Model: Social Studies CBT-Confidence (Intervention Group)*

| Model | *R* | $R^{2\,b}$ | Adjusted $R^2$ | Std. error of the estimate |
|---|---|---|---|---|
| 1 CompletedLevels | .805[a] | 0.647 | 0.629 | 0.982 |
| 2 LinesCoded | .857[c] | 0.734 | 0.704 | 0.877 |
| 3 TECHUSE | .908[d] | 0.825 | 0.794 | 0.732 |

*Note*. [a]Predictors: CompletedLevels. [b]For regression through the origin (the no-intercept model), [c]Predictors: CompletedLevels, LinesCoded. [d]Predictors: CompletedLevels, LinesCoded, TECHUSE.

Table 11
*ANOVA: Change in Social Studies CBT-Confidence with Intervention Variables* [a, b]

| Model | | Sum of squares | *df* | Mean square | F | Sig. |
|---|---|---|---|---|---|---|
| | Regression | 33.666 | 1 | 33.666 | 34.888 | .000[c] |
| | Residual | 18.334 | 19 | 0.965 | | |
| | Total | 52.000[d] | 20 | | | |
| 2 | Regression | 38.163 | 2 | 19.082 | 24.823 | .000[e] |
| | Residual | 13.837 | 18 | 0.769 | | |
| | Total | 52.000[d] | 20 | | | |
| 3 | Regression | 42.888 | 3 | 14.296 | 26.673 | .000[f] |
| | Residual | 9.112 | 17 | 0.536 | | |
| | Total | 52.000 | 20 | | | |

*Note*. [a] ΔSSConf. [b]Linear regression through the origin. [c]Predictors: CompletedLevels. [e]Predictors: CompletedLevels, LinesCoded. [f]Predictors: CompletedLevels, LinesCoded, TECHUSE.

Table 12
*Social Studies Variables Included in Intervention Group* [a, b]

| | | Unstandardized coefficients | | Standardized coefficients | | |
|---|---|---|---|---|---|---|
| Model | | *B* | Std. error | Beta | *t* | Sig. |
| 1 | CompletedLevels | 0.015 | 0.003 | 0.805 | 5.907 | 0.000 |
| 2 | CompletedLevels | 0.032 | 0.007 | 1.652 | 4.455 | 0.000 |
| | LinesCoded | -0.001 | 0.001 | -0.897 | -2.419 | 0.026 |
| 3 | CompletedLevels | 0.027 | 0.006 | 1.399 | 4.359 | 0.000 |
| | LinesCoded | -0.002 | 0.001 | -1.152 | -3.585 | 0.002 |
| | TECHUSE | 0.176 | 0.059 | 0.584 | 2.969 | 0.009 |

**Mathematics CBT-Confidence with Intervention Group.** Stepwise linear regression and ANOVA analyses were conducted to determine the relationship significance between change in mathematics CBT-confidence [ΔMConf], Technology-Use Baseline [TechUse], and the intervention variables [CompletedLevels and LinesCoded]. Results did not indicate any significant relationships among the variables ($p = 0.595$, Tables 13, 14, 15), even though ΔMATH and MATHPOSTSCORE were also included.

Table 13
*Regression Model: Mathematics CBT-Confidence (Intervention Group)*

| Model | *R* | $R^{2\ b}$ | Adjusted $R^2$ | Std. error of the estimate |
|---|---|---|---|---|
| 1 | .448[a] | 0.201 | -0.065 | 0.462 |

Note. [a]Predictors: MATHPOSTSCORE, TECHUSE, ΔMATH, LinesCoded, CompletedLevels.

Table 14
*ANOVA: Change in Mathematics CBT-Confidence with Intervention Variables [a, b]*

| Model | | Sum of squares | *df* | Mean square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 0.804 | 5 | 0.161 | 0.755 | .595[c] |
| | Residual | 3.196 | 15 | 0.213 | | |
| | Total | 4.000[d] | 20 | | | |

*Note*. [a]ΔMConf. [b]Linear regression through the origin. [c]Predictors: MATHPOSTSCORE, TECHUSE, ΔMATH, LinesCoded, CompletedLevels.

Table 15
*Mathematics Variables Included in Intervention Group [a, b]*

| Model | | Unstandardized coefficients | | Standardized coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. error | Beta | *t* | Sig. |
| 1 | TECHUSE | -0.036 | 0.038 | -0.426 | -0.936 | 0.364 |
| | LinesCoded | 0.000 | 0.000 | 0.602 | 0.817 | 0.427 |
| | CompletedLevels | 0.003 | 0.005 | 0.640 | 0.643 | 0.530 |
| | ΔMATH | 0.023 | 0.056 | 0.184 | 0.423 | 0.679 |
| | MATHPOSTSCORE | -0.054 | 0.048 | -0.815 | -1.130 | 0.276 |

Note. [a]ΔMConf. [b]Linear regression through the origin.

## Conclusions

**Research Question #1.** The results of overall change in social studies CBT-confidence [ΔSSconf] among both participant groups showed that the intervention group increased by 1.3 in social studies CBT-confidence (Table 4) while in the control group decreased by -0.33 (Table 5).

Additionally, overall change in social studies performance [ΔSS] among both groups was higher in the intervention group (4.1, Table 4) than in the control group (0.29, Table 5). Results of regression and ANOVA analyses found a significant relationship between ΔSS and ΔSSConf ($F(1,40) = 19.884$, $p<.001$, Tables 6,7). Based on social studies performance and CBT-confidence results, the researcher confirmed hypothesis ($H_{a1}$) that stated, the intervention group had significantly higher mean scores in social studies CBT-confidence and social studies performance than the control group.

The results of overall change in mathematics CBT-confidence [ΔMconf] among both participant groups showed a small increase in intervention group mean score of mathematics CBT-confidence (0.1, Table 4) while the control group decreased (-0.38, Table 5). Additionally, the results of overall change in mathematics performance among both participant groups showed an increase of 2.55 in the intervention group (Table 4) and an increase of 0.9 for the control group (Table 5). Regression and ANOVA analyses did not find a significant relationship between mathematics performance and CBT-confidence ($R=0.06$, Table 8, $F(3,38)=0.865$, $p=.467$, Table 9). Based on mathematics performance and CBT-confidence results, the researcher rejected hypothesis ($H_{b1}$) and accepted the null hypothesis ($H_{b0}$) that stated, there were no significant differences in mean scores in mathematics CBT-confidence and mathematics performance among intervention and control groups.

**Research Question #2.** In gauging the technology affective filter with the intervention group, the results of overall change in social studies CBT-confidence [ΔSSConf] within the intervention group found three regression models that demonstrated a statistically significant relationship between the intervention variables (completed levels, lines coded), technology use and change in social studies CBT-confidence. Regression Model 3 [$R = .908$] provided the most significant relationship ($F(3,17) = 26.673$. $p < .001$), with 79.4% of the variance explained (Tables 10, 11, 12). With a significant relationship between change in social studies CBT-confidence [ΔSSConf], coding levels completed [LevelsCompleted], and lines coded [LinesCoded], the researcher confirmed hypothesis ($H_{c1}$) that stated, the mean score of change in social studies CBT-confidence of the intervention group had a direct (positive) significant relationship with coding levels completed and lines coded.

The results of overall change in mathematics CBT-confidence within the intervention group failed to find any significant relationships between mathematics CBT-confidence [ΔMConf], Technology-Use Baseline [TechUse], and the intervention variables [CompletedLevels and LinesCoded] ($p = 0.595$, Tables 13, 14, 15). Therefore, the researcher rejected hypothesis ($H_{d1}$) and accepted the null hypothesis ($H_{d0}$) that stated, there were no significant differences between mean score of change in mathematics CBT-confidence, coding levels completed, and lines coded of the intervention group.

# CHAPTER FIVE

# DISCUSSION

## Overview of the Study

The research study wanted to determine the relationship between digital literacy intervention and computer-based testing (CBT) confidence as measured by student performance on third grade social studies and mathematics assessments. The research study included 41 total participants with an intervention group (n=20) that received a digital literacy intervention using coding and keyboarding modules, and a control group (n=21) that received a mock intervention using digital news magazines.

This chapter includes discussion and explanation of the major findings. The discussion focuses on why the technology affective filter digital divide framework outlined with the conceptual framework (Figures 4 and 5) contributed to statistically significant social studies performance and CBT-Confidence outcomes. The research study results suggest a new technology affective filter framework that combines existing ICT-Digital Divide and affective filter frameworks. In recognizing that the mathematics performance and CBT outcomes were not met, anecdotal evidence along with relevant research is included to explain lack of significant mathematics outcomes. The chapter concludes with recommendation for future research pertaining to expanding this research.

## Discussion and Analysis of Findings

In determining the relationship between third grade computer-based testing (CBT) confidence and student performance in social studies and mathematics in both participant groups, the research study results confirmed that the intervention group had a significantly higher mean score in social studies CBT-confidence and social studies performance than the control group. The study also confirmed no significant differences in mean scores in mathematics CBT-confidence and mathematics performance among intervention and control groups. The research study findings led the researcher to suggest that there is a significant relationship between third grade computer-based testing confidence and social studies, but no significant relationship between CBT-confidence and student performance in mathematics.

In determining the relationship between coding levels completed and lines coded on the CBT-confidence in social studies and mathematics of the intervention group, the research study found the mean score of change in social studies CBT-confidence of the intervention group had a direct (positive) significant relationship with coding levels completed and lines coded. The study also confirmed no significant differences between mean scores of change in mathematics CBT-confidence, coding levels completed, and lines coded of the intervention group. The research study findings led the researcher to also suggest that there is a direct (positive) relationship between coding levels completed and lines coded on CBT-confidence in social studies but found no relationship between coding levels completed and lines coded on CBT-confidence in mathematics.

**Technology Use.** The Technology-Use Baseline results showed that the intervention group reported a lower average technology use at home (M=4.6, Table 4) compared to the control group (M=6.3, Table 5). Considering that the digital literacy intervention consisted of coding and creating a video game segment, Technology-Use Baseline found 73% of participants in both groups had a video game system compared to having a computer connected to the internet at home (39%, Table 2). Furthermore, 86% of the control group reported playing online games compared to 45% of the intervention group. With many of both participant groups using a video game system compared to a computer, the digital literacy intervention aligned with the primary mode of participants' technology use (Have: Video Game System: 70% intervention group, 76% control group, 73% both groups, Table 2). This sample population at ABC Elementary mirrored similar, larger high-poverty communities with limited computer ownership and higher ownership of smartphone, tablet and video game systems (Ito et al., 2010, U.S. Census Bureau, 2014). Furthermore, the technology use disparity between the intervention and control groups demonstrated a digital divide within third grade classrooms at a high-poverty school.

While acknowledging the similarities between the sample population and under resourced student populations in high-poverty schools, the Technology-Use Baseline showed that participant groups mostly used technology for low-level purposes (i.e. surfing the net, playing video games). Margolis et al. (2008) argued that low-level technology experiences, like the ones listed on the Technology-Use Baseline, are common-place in marginalized communities and contribute to limited technological competencies. The Technology-Use Baseline survey asked mostly about passive technology use (low-level intellectual task). While the survey provided open response space for explanation, most participants in both groups listed low-level passive digital content consumption. While the survey did not list high-level technology use options (i.e. mobile application creation, robotics/coding games), two participants listed using technology to study for better test grades. The researcher suggested revisions to the Technology-Use Baseline survey to include high-level technology use options on the survey.

**CBT-Confidence.** While most equate higher technology use with lower affective filter due to higher confidence with technology, the digital literacy intervention incorporated routine technology access and high-level technology skills development to build confidence with technology so that the intervention group participants could create a video game segment. The technology affective filter digital divide framework suggested that more routine technology use and high-level technology skills development would reduce affective filter and, consequently, improve CBT-confidence and student performance. The research study found significant relationships between social studies CBT-confidence and social studies student performance.

With a higher Technology-Use Baseline score, the control group initially had an average higher social studies CBT-confidence score during the social studies pretest administration (M=2.81, SD=0.981, Table 5) compared to the intervention group (M=1.70, SD=0.571, Table 4). The social studies pretest scores [SSPRESCORE] were similar between both groups with the intervention group slightly ahead (M=4.40, Table 4) compared to the control group (M=4.24, Table 5), meaning that other variables may have an impact as observed in the low percentage of variance explained (Table 5).

While the control group had higher average technology use, they also reported a higher average social studies pretest CBT-confidence. Upon retaking the same posttest, the control group participants decreased in CBT-confidence in both social studies and mathematics. Similarly, the intervention group showed marginal growth mathematics CBT-confidence (M=.10, Table 4) while the control group decreased (M=-0.38, Table 5). Perceived competence may have factored into the control group decrease in confidence and contributed to the variance of CBT-confidence variables.

**Perceived Competence.** The CBT-confidence survey measured participant's self-reported computer-based testing confidence, while the computer-based pretest and posttest in social studies and mathematics were performance-based assessments. Participants did not receive feedback regarding the computer-based pretests and posttests. A student believing that s/he had a higher perceived score could complete the CBT-confidence survey with a higher score – even if the student unknowingly scored very low on the actual pretest and posttest. Student perceptions of perceived competence, while not considered in this research study, may have contributed to the variance of CBT-confidence variables and explain the differences. Arnone, Small, and Reynolds (2010) established "perceptions of competence increase feelings of confidence and self-efficacy (perceptions of ability to reach a goal or perform a task)" (p. 2). Like the affective filter theory, negative perceptions of competence also impact confidence (Arnone et al., 2010). In thinking that a test was too difficult, a student would have low confidence. Perceived competence, while not a measured variable in this research study, factored into the differences with CBT-confidence scores. The researcher suggested revisions to research design incorporating CBT-confidence surveys before and after pretest administration and again during posttest administration to control for perceived competence as a potential moderating variable to CBT-confidence.

Results also confirmed the technology affective filter digital divide framework when applied to social studies. Furthermore, the research study found significant relationships between the variables of social studies performance and social studies CBT-confidence ($F(1,40)=19.884$, $p < .001$) (Table 6, 7). While the R value ($R^2=.332$, Table 6) indicated that other variables may help explain the differences in social studies performance [ΔSS], mode of technology integration and high-level pedagogical practices might also contribute (Chang, 2017, Margolis et al., 2008).

**Learner-centered versus teacher-centered technology integration.** To better understand the different results on social studies and mathematics performance and CBT-confidence, the researcher, in the role of teacher, engaged in professional discussions with the third grade mathematics and social studies teachers about technology use within the classroom. The following anecdotal evidence offered insights that explained differences among social studies and mathematics research outcomes.

***Third grade social studies and science classroom.*** A digital immigrant teacher led the third grade social studies and science instruction at ABC Elementary. The teacher reported actively participating in science, technology, engineering, arts, mathematics (STEAM) professional development trainings and instructional technology developments. While not abreast of all current technologies, the teacher expressed a willingness to integrate new technologies, but voiced concern over school district technology policies sometimes limiting streaming instructional videos, including many social studies clips recommended by the state department of education. This teacher also admitted that the district gatekeeping of streaming of instructional video clips impacted his instructional planning due to the amount of time required to find work-arounds to integrate technologies.

In the past, the third grade social studies and science teacher incorporated digital research projects and student blogging within the classroom. Students researched African American inventors and trailblazers. Each student developed a digital page to showcase his or her research about the person and the person's impacts on the community. Furthermore, students blogged positive comments with questions and responses. The teacher planned on continuing the project and incorporating virtual field trips to historical sites, museums, laboratories, and places around the world. Teacher's frustration with technology limited plans for technology integration within the classroom during the current academic school year.

***Third grade mathematics classroom.*** A digital immigrant teacher led the third grade mathematics instruction at ABC Elementary. This mathematics teacher reported actively using an interactive whiteboard and document camera for classroom instruction. When asked about technology instructional use, the mathematics teacher described allowing students to come to the board to use the interactive pen to write or reveal the answer. Furthermore, the teacher described the various instructional websites used to supplement whole-group math instruction. This teacher did not voice any concerns about district technology polices, however, the teacher admitted only using teacher subscription services such as Khan Academy videos, Flocabulary, and BrainPop to show students how to do math.

When asked about student technology use, the math teacher cited lack of enough "working" computers and frustration with having to address computer issues during math instruction. The teacher commented, "I have so much to teach in 90 minutes. I would have to be a technician to address all the issues with these computers." The math teacher gave further explanation that students completed the district benchmark test on paper. Upon having to enter answers on the computer, the students struggled with computer issues, combined with basic issues with student logons. When asked about project-based learning, the math teacher stated that students show what they know on paper and with hand-held manipulatives (i.e. base-ten blocks and fraction tiles). The teacher showed examples of student collaborations on past multiplication and division projects on poster-sized paper.

While the research study analysis did not indicate statistical significance of the digital intervention on mathematics, the anecdotal evidence suggested that the mode of technology integration affected the research study results in terms of student performance and student confidence across content areas. Krashen (1982) contended that classroom learning environments determine the impact of student knowledge acquisition and application on student tasks and assessments. As seen with mathematics performance and CBT-confidence, teacher-centered technology integration lacked effectiveness as learner-centered technology integration.

Teacher-centered model of technology integration may explain the lack of statistical significance with mathematics outcomes. The mathematics teacher described the math instructional model that included standard lecture, demonstration, and both guided and independent practice in which the teacher used media clips to introduce new content and supplement content understanding. The teacher-centered model of technology integration involves a teacher using technology to show content or live interaction of manipulatives. This teacher-centered model, fraught with low-level student technology interactions, aligned with the mathematics outcomes of this research study. Digital native learners are accustomed to this passive consumption of these low-level intellectual tasks that do not facilitate learning (Considine et al, 2009; Ito et al., 2010; U.S. Department of Education Office of Educational Technology, 2016). Both groups received this teacher-centered model of technology integration in mathematics every day. On the contrary, both participant groups received some form of routine learner-centered technology interaction during the digital literacy intervention or mock interventions in the social studies instructional block.

Guy and Marquis (2016) described new instructional methods, like flipped and blended learning environments, that engage digital natives with technology as a form of learner-centered model of technology integration. The learner-centered mode of technology integration engaged active learning and developed critical thinking through use of interactive technologies. Students have high-level interactions via hands-on methods used to critically evaluate and manipulate digital information with a digital production outcome (Barron et al., 2010). The current study's digital intervention involved high-level learner-centered technology integration with critical development of computational thinking via PP and coding modules to create a video game segment. On the other hand, low-level use of technology in the mock intervention for the control group participants did not involve the creation of a product. The mock intervention involved learner-centered technology integration in the form of participant login to the *Scholastic News – Grade 3* website, accessing online tools to digital read informational text, and self-selecting informational media clips. Both interventions served as learner-centered technology integration because students—not the teacher—self-guided the integration within one's own learning.

**Technology Affective Filter.** A higher percentage (73%) of the study's digital native participants acknowledged having or using a smartphone as primary use of technology at home. The Technology-Use Baseline data aligned with existing research suggesting that students from marginalized communities primarily use technology for entertainment purposes such as watching videos and playing online games (Ritterband & Heller, 2015).

Upon review of pretest question results for outliers, the researcher found that every student in both participant groups did not correctly answer question 1 on the social studies pretest. The constructed response question asked participants to, "Describe how the early Native American tribes in Louisiana contributed to Louisiana's culture today?" (DRC, 2017b). The question required participants to navigate computer features to scroll to read four sources, think of a response, type a composition, and edit a composition only using the computer (see Figure 6). During the pretest, many participants struggled with proper login because the secure EAGLE 2.0 testing portal required students to enter complex usernames and unique passwords that incorporated upper and lowercase letters and numbers.  As per testing security protocol, the researcher could not control username and password creation.  Many students in both groups struggled, some even sobbed, through multiple login attempts that took several minutes.  These factors, combined with taking the actual computer-based pretest, contributed to a higher technological affective filter.   After the digital literacy intervention, zero students in the control group (0%) and nine students in the intervention group (45%) correctly answered the same question during the posttest.  This result aligned with the social studies performance and CBT-confidence research outcomes in the first research question.

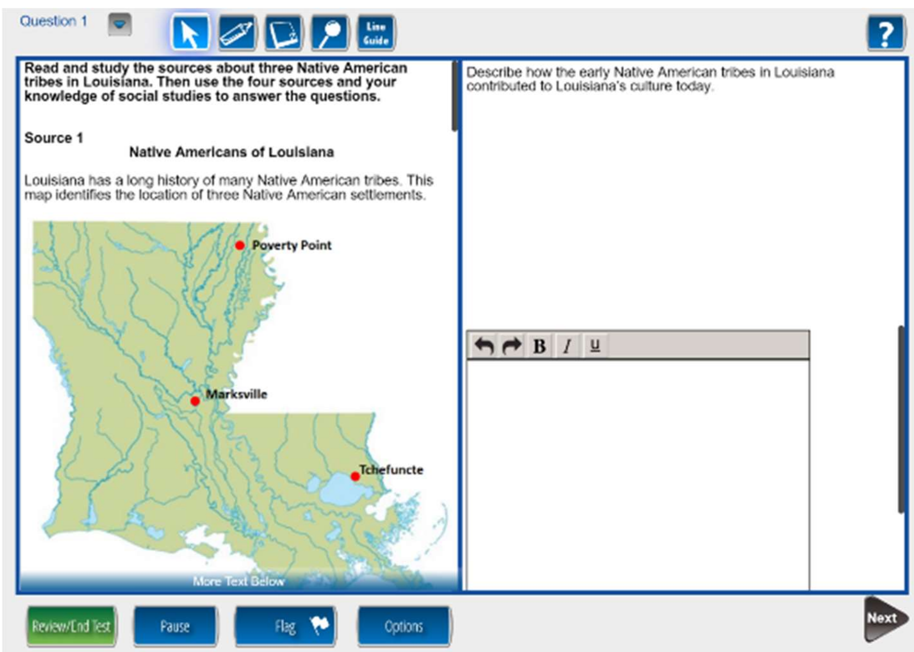



*Figure 6*.  First question: Social studies pre–post-test (DRC, 2017b).

Krashen (1982) identified the affective filter as complex of negative emotional factors that interfere with cognitive reception and processing of new language within the classroom. Considering that in this research study, intervention group participants began the process of learning a new language of technology through the development of keyboarding and coding skills.  The conceptual framework implemented in this research study (Figures 4 and 5) considered the use of a new term "technology affective filter" that should be considered when addressing barriers that inhibit student learning via technology (Gomez et al., 2014).

**New Technology Affective Filter Framework.** Krashen's (1982) theories on language development and cognition acknowledged that individuals struggle with learning a new concept. With the affective filter theory rooted in language development, the technology affective filter framework suggested that technological language development, this "language of technology," become commonplace when developing instructional practices integrating learner-centered technology within modern classrooms. Furthermore, learner-centered technology integration supports individual access to the information communication technology (ICT) digital divide framework. Students from marginalized, under resourced communities already enter the technology affective filter framework with a high affective filter because they lacked regular access and use of high-level computer technologies (Kim & Kim, 2001).

The research study introduced a technology affective filter digital divide framework (Figure 3) adapted from the ICT-digital divide framework (Hohlfield et al., 2008) and it lowered the affective filter barrier in three stages by raising student confidence taking computer-based tests through technology skills development. Anxiety, motivation, and self-confidence are three constructs that make up the affective filter theory (Krashen, 1982). The first tier of the technology affective filter framework, for the intervention group (Figure 3) involved providing routine access to school infrastructure via low-level intellectual tasks such as Typing.com (n.d.) keyboarding modules and login support. This first stage introduced the learner to a new concept with high anxiety and low confidence. Tavani and Losh (2003) found a statistically significant relationship between motivation, self-confidence, and encouragement and student performance.

Tavani and Losh stated, “The higher the level of self-confidence a student perceives, the higher the level of expectations he or she will portray” (p. 4).

The second tier of the technology affective filter framework involved actual use of technology in the classroom via high-level technology tasks such as using Code.org (n.d.) modules to develop ICT and computational thinking skills. Tavani and Losh (2003) found a significant correlation between confidence levels and academic success. Furthermore, Vygotsky (1978) suggested that social interactions and scaffolding develop confidence and effective cognitive growth through zone of proximal development. Ghaderi and Nikou (2016) suggested that learner-centered model of technology integration encourages peer interactions and collaborations to share knowledge and reduce stress with challenging tasks.

The final tier of the technology affective filter framework involved the empowerment of individual students to use this newly developed technological language to create a new form of technology. The digital literacy intervention tasked participants in the intervention group to create a video game segment in Play Lab. This culminating activity depended on progressive technology skills development through the coding modules. Some participants skipped levels to catch up with classmates during peer programming; however, participants reluctantly returned to earlier levels because the puzzle required necessary coding skill level to complete the level.

In this ultimate tier intervention group participants should have had a higher confidence level with lower stress because the coding modules scaffolded technological skills development through the digital literacy intervention. Pope et al. (2002) also found computer confidence highly correlated with computer anxiety and attitudes. This research study chronicled how an under resourced, high-poverty elementary school implemented a brief, learner-centered digital literacy intervention to reduce the technology affective filter and increase CBT-confidence of third graders.  The study results found a significant relationship with a change in student performance and computer-based testing confidence in social studies, and a direct, positive significant relationship with the coding intervention and change in computer-based testing confidence in social studies.

**Limitations**

The researcher served as the social studies teacher and delivered the digital literacy and mock interventions within this research study.  While a major limitation and a threat to internal validity, the teacher-researcher involved an external faculty member to ensure randomization of participant groups.  Acknowledging that both intervention and control groups received some form of student-centered technology skills development from the digital literacy intervention or the mock intervention during the social studies block, the teacher-researcher could not control for the instructional practices within the mathematics classroom.  Future research suggestions would include implementing study within a self-contained classroom or utilizing one teacher to teach same subjects to both participant groups.

One major study limitation included the sample size ($N = 41$), which served as a threat to internal validity.  The limited size may have influenced both social studies and mathematics outcomes.  Future research plans suggest a larger group of the same grade level students in the same subject areas at various schools throughout the district in which this study took place.

Maturation served as a standard threat to internal validity with the same pretest and posttest assessments.  The brief six-week research study timeline may have contributed maturation errors with four weeks separating pretest and posttest administration.  While the researcher did not mention the details of the pre–posttests to the participants, the EAGLE 2.0 did not allow for randomization of test questions.  The randomization of questions on a computer-based test controls for instrumentation by reducing opportunities for cheating. Additionally, random selection of the cluster groups controlled for bias; however, the researcher could not control for the group composition, while the control group composition had higher representation of men (55%), the intervention group had higher representation of minority students (100%) than the control group (95%). Literature suggested that males may have more interest than females in developing technological skills; while minority students may have more limitations to access ICT (Gomez, Gomez, & Gifford, 2010, Menon, 2015).

PP served to alleviate computer shortages because two students worked at each computer workstation. Schools with one-to-one computer access may provide computers to individual students; however, students with low computer or programming confidence may need PP to boost confidence with technology use. PP may have impacted the validity of the intervention variables relating to the measurement of [LinesCoded] and [CompletedLevels].

The researcher created the Technology-Use Baseline and CBT-confidence surveys for third grade students with kid-friendly language; however, the short surveys needed to be field tested with a larger population to validate the instrument by reducing bias and ensuring greater readability and understanding. While an important variable, the CBT-confidence survey asked one question to ascertain participant's self-confidence with kid-friendly language. The question asked, "How do you feel about taking a test on the computer?" instead of "How confident are you with computer-based tests?" The answer choices imply student bias by equivocating confidence with letter grades and levels of accomplishment. Knowing that most third grade students understand grades, perceived competence factored into participant responses self-grading computer-based testing confidence. Recognizing overall effort to limit CBT-confidence survey length after taking a lengthy computer-based test, the researcher recommends revision of methods to measure CBT-confidence by providing "I can" statements describing confidence levels. Furthermore, the existing CBT-confidence question could be used to gauge perceived confidence. This perceived confidence score could be compared to scaled assessment score.

Modifications to the instrumentation for the intervention variables should consider including a reliable pre-post typing assessment to measure the foundational technology skill on the technology affective filter digital divide framework. When combined with the existing intervention variables [LinesCoded and CompletedLevels], a typing skills pretest and posttest would provide a comprehensive assessment of the technology skills needed within digital literacy intervention.

Another limitation involved instrumentation factors with children participants self-reporting CBT-confidence. CBT-confidence data may have been influenced by extraneous factors like inexperience taking confidence surveys, and perceived competence. The researcher failed to control for perceived competence when designing the CBT-confidence variable and instrumentation. To control for internal validity, the researcher suggests a research design modification to include a perceived competence variable. This modification could involve surveying participant CBT-confidence level before and after each pretest and again after each posttest. The change in confidence could be grouped with test score to factor perceived competence within construct variable of CBT-confidence.

In recognizing the challenges of measuring true student performance on assessments, the researcher did not secure participant report card grades to account for core-content understanding because other unreliable measures like homework, class participation, quizzes contribute to a participant's average grade in a core content area.

## Implications for Policy and Practice

**Technology Pedagogical Integration.** While the American Academy of Pediatricians (AAP, 2016) revised its "no more than two hours" recommendation on media technology use for children, the policy makers should consider ramifications of general and conflicting policy statements; however, these policy committees should invest resources in under resourced schools to encourage more intentional and appropriate technology use within classrooms as NAEYC and Fred Rogers Center (2012) recommend.

Digital immigrant administrators and leadership currently make most of the decisions regarding digital native technology use. School and district leadership should seek input from all stakeholders including digital native students. Recognizing that digital immigrant educators are slow to embrace new technologies (Gomez et al., 2010), a committee of digital immigrant school members and digital native students should be tasked to share and learn about the new technology and investigate opportunities for use within the classroom instead of restricting, banning, and/or punishing digital native students for technology use (Zhong et al., 2017).

Similarly, school leaders should consider providing teacher professional development opportunities for learner-centered technology integration (Chow et al., 2012, Considine et al., 2009). Pope et al. (2002) suggested that digital immigrant educators develop technology pedagogical practices through modeled-forms of technology integration that incorporate the technology affective filter framework. Teachers could observe, develop confidence with technology instructional practices within the modeled classroom, and create technology integration plan for use within one's own classroom. This professional development opportunity does not require expensive trips to conferences, but a simple need for a school professional learning community that embraces constructivist practices of modeling and shared learning between digital native learners and digital immigrant teachers.

Learner-centered technology integration embrace constructivist learning practices that support digital immigrant educators learning from digital native students. While Pope et al. (2002) suggested that digital immigrant teachers learn from modeled technology integration in the classroom, constructivist classroom practices of shared learning between digital immigrant teacher and digital native students can lead to increased technology confidences between digital natives and their digital immigrant educators (Zhong et al., 2017). If digital immigrant teachers and digital native students share their learning about technology, digital immigrant teachers could possibly engage students in higher-level technology use within any classroom by recognizing and building technology confidence within the classroom through shared learning.

**Affective Filter.** With affective filter research focused primarily on psychological impacts on language development and knowledge, this research study wanted to expand the affective filter theory to include technology as a form of language development. Similar to needing necessary skills to become fluent with a language, students must develop the necessary technology skills to become fluent with technology. This research study hopefully started the conversation about the need for students to build confidence with technology, and how it can limit cognition and content mastery. The technology affective filter digital divide framework provided a constructivist approach to technology integration that incorporates three affective filter constructs: self-confidence, motivation, and anxiety (Krashen, 1982). While this research study focused on the self-confidence construct, future research could address the other construct components (motivation and anxiety).

**Marginalized Communities.** While ABC Elementary had limited technologies and a high student-to-computer ratio (1.6 students: 1 computer), pair programming (PP) helped strengthen collaboration and communication within the classroom so that fewer computers were needed. Participants enjoyed PP and often self-selected to use PP. At the end of the study, every third grader received access to the Code.org (n.d.) class page to extend research study benefits to participants in the control group. While not part of social studies and science homework, many students asked if the coding site would work on smartphones. The PP approach might have impacted the study results with measurement of the intervention variables.

Marginalized and under resourced communities should consider devoting 30 instructional minutes to introduce coding practices with minimal disruption to the standard curriculum. The digital literacy interventions used for this research study consisted of a modest, 30 minutes instructional block. The research implication may impact technology integration and standard pedagogical practices from early childhood through high school.

**Technology-Use Ratio.** School leaders and instructional staff of marginalized and under resourced schools should consider Technology-Use ratio with the practical implementation of this research study. The third grade teachers at ABC Elementary shared 35 laptops between 70 students with a Technology-Use ratio of 2 students to 1 computer. Pair programming (PP) increased the number of available computers while also providing a collaborative learning environment where students discussed and shared strategies. For successful learner-centered technology integration within an under resourced classroom, the teacher must figure out the actual number of working technology devices (actual Technology-Use ratio). Subsequently, the teacher can develop an action plan to maximize student high-level interactions with the available technology (Zhong et al., 2017). Future research should consider studying pair programming in under resourced classrooms and classrooms with scarce to no technology resources.

**Recommendations for Future Research**

Considering that this research study had a small sample size (*n*=41), future research could include measuring the effects of similar digital intervention on multiple third grade mathematics classrooms at various schools within a single school district. A revision of the intervention, specifically for mathematics, future research suggestions would include implementing study within a self-contained classroom or utilizing one teacher to teach same subjects to both participant groups. Furthermore, the research study could be expanded to other content areas including English language arts (ELA) and science in a single testing grade. With additional resources, the school district could pilot a case study measuring the effects of computer-based testing with all testing grades at a school site.

Future research should also consider including investigation of related populations of digital natives with limited technologies and measure the effects of technology affective filter on CBT-confidence and student performance with English Language Learners (ELL). Affective filter theory research developed from Krashen and Tracy (1982) studied the psychological effects of stress/anxiety, confidence and motivation on language development. The researcher suggests revisiting this study with ELL students within marginalized, under-resourced, high-poverty schools and high ELL student populations. Additional future research opportunities could involve digital natives and specific subgroups of marginalized communities (e.g., gender, learning styles).

The research study could not study the long-term effects of the digital literacy intervention on student performance and CBT-confidence. The brief timeline could have impacted the measurement of student performance.  Therefore, the researcher recommends longitudinal research study with same digital literacy intervention spanning one academic school year.

Modifications to this research study could include the development of an early-childhood Technology-Use Baseline and overall technology confidence survey to measure the technology affective filter within children.  Teachers and school leaders could use the surveys to understand technology confidence at various levels within the classroom, school, or district.  Stakeholders can use these surveys to revise assignments of technological resources in schools/district and modify the core curriculum to meet individual, groups, and school technological needs.

## REFERENCES


Alodiedat, A. S., & Eyadat, Y. A. (2008). The Effect of Intranet Use on Students' Achievement and Self-Confidence. International Management Review, 4(1), 72. Retrieved from Questia.

American Academy of Pediatrics (AAP). Council on Communications and Media. (2016). American Academy of Pediatrics: Media use in school-aged children and adolescents. *Pediatrics*, *138*(5), 1–6.

Arnone, M. P., Small, R. V., & Reynolds, R. (2010). Supporting Inquiry by Identifying Gaps in Student Confidence: Development of a Measure of Perceived Competence. School Libraries Worldwide, 16(1), 47. Retrieved from Questia.

Ashbrook, P. (2017). Integrating digital tools. *Science and Children, 54*(5), 20. Retrieved from Questia.

Barron, B, Walter, S., Martin, C. K., & Schatz, C. (2010). Predictors of creative computing participation and profiles of experience in to Silicon Valley middle schools. *Computers & Education*, *5*(1), 178–189.

Brozo, W. G., Shiel, G., & Topping, K. (2007). Engagement in reading: Lessons learned from three PISA countries. *Journal of Adolescent & Adult Literacy, 51*(5), 304–315.

Campbell, C. (2014, April). Children's librarians as digital media mentors [Web blog post]. Retrieved from http://www.fredrogerscenter.org/2014/04/14/childrens-librarians-as-digital-media-mentors/

Chang, R. (2017). Genera Walters: How tech can close the achievement gap: Students who struggle need more technology, not less. *T H E Journal (Technological Horizons in Education), 44*(1). Retrieved from Questia.

Chow, A. S., Smith, K. M., & Sun, K. (2012). Youth as design partners: Age-appropriate websites for middle and high school students. *Educational Technology & Society, 15*(4), 89. Retrieved from Questia.

Code.org (n.d.). *Course C*. Retrieved from https://curriculum.code.org/csf-1718/coursec/

Considine, D., Horton, J., & Moorman, G. (2009, March). Teaching and reading the millennial generation through media literacy. *International Reading Association–Journal of Adolescent & Adult Literacy, 52*(6), 471–481.

Cook, M. D., & Evans, W. N. (2000, October). Families or schools? Explaining the convergence in White and Black academic performance. *Journal of Labor Economics, 18*(4), 729.

Data Recognition Corporation (DRC). (2017a). EAGLE 2.0 CBT–Mathematics Grade 3 Assessment [Measurement instrument]. Retrieved from https://www.drcedirect.com/all/eca-portal-ui/welcome/LA

Data Recognition Corporation (DRC). (2017b). EAGLE 2.0 CBT–Social Studies Grade 3 Assessment [Measurement instrument]. Retrieved from https://www.drcedirect.com/all/eca-portal-ui/welcome/LA

Dawes, L., Mercer, N., & Wegerif, R. (2000). Chapter 3: Extending talking and reasoning skills using ICT. In M. Leask & J. Meadows (Eds.), *Teaching and learning with ICT in the primary school* (pp. 39–64). London, England: Routledge. Retrieved from Questia.

Del Moral, M. E., Cernea, A., & Villalustre, L. (2013). Connectivist learning objects and learning styles. *Interdisciplinary Journal of E-Skills and Lifelong Learning, 9*, 105. Retrieved from Questia.

Delpit, L. (2006). *Other people's children: Cultural conflict in the classroom.* New York, NY: New Press.

DeVries, R. & Zan, B. (1994). *Moral classrooms, moral children: Creating a constructivist atmosphere in early education*. New York, NY: Teachers College Press.

Diaz, V. (2008). Relationships between district size, socioeconomics, expenditures, and student achievement in Washington. *Rural Educator, 29*(3), 30. Retrieved from Questia.

Digital Literacy: Preparing Students for a Global Tech-Based Economy. (2012, December). *District Administration*, *48*(11). Retrieved from https://www.districtadministration.com/article/digital-literacy-preparing-students-global-tech-based-economy

Dillenbourg, P., Baker, M., Blaye, A. & O'Malley, C. (1996). The evolution of research on collaborative learning. In E. Spada & P. Reiman (Eds.), *Learning in humans and machines: Towards and interdisciplinary learning science* (pp. 189–211). Oxford, England: Elsevier.

DiMaggio, P, Hargittai, E., Celeste, C., & Schafer, S. (2004). Digital inequality: From unequal access to differentiated use. In K. Neckerman (Ed.), *Social inequality* (pp. 355–400). New York, NY: Russell Sage Foundation.

Donlevy, J. (2006). Teachers, technology and training: A New Year's resolution for 2006: Closing the achievement gap. *International Journal of Instructional Media, 33*(1), 1. Retrieved from Questia.

Emanuel, J. (2013). Digital native librarians, technology skills, and their relationship with technology. *Information Technology and Libraries*, *32*(3), 20. Retrieved from Questia.

Every Student Succeeds Act of 2015 (ESSA) Pub. L. No. 114-95 § 114 Stat. 1177 (2015-2016).

Ghaderi, M., & Nikou, F. R. (2016). The relationship between Krashen's affective filter hypothesis and Iranian EFL learners' writing skill. *Modern Journal of Language Teaching Methods, 6*(1), 264. Retrieved from Questia.

Gningue, S. M., Peach, R., & Schroder, B. (2013). Developing Effective Mathematics Teaching: Assessing Content and Pedagogical Knowledge, Student-Centered Teaching, and Student Engagement. *The Mathematics Enthusiast, 10*(3), 621. Retrieved from Questia.

Gomez, K., Barron, B., & Pinkard, N. (2014). *The digital youth network: Cultivating digital media citizenship in urban communities.* Cambridge, MA: MIT Press.

Gomez, L. M., Gomez, K., & Gifford, R. (2010, August). *Educational innovation with technology: A new look at scale and opportunity to learn*. Paper presented at the Aspen Institute Congressional Conference Whistler, British Columbia.

Gonzales, N. A., Cauce, A. M., Friedman, R. J., & Mason, C. A. (1996, June). Family, peer, and neighborhood influences on academic achievement among African American adolescents: One-year prospective effects. *American Journal of Community Psychology, 24*(3), 365.

Gonzalez, C., (2004). Role of blended learning in the world of technology. Retrieved from http://www.unt.edu/benchmarks/archives/2004/september04/eis.htm

Gosine, K., & Islam, F. (2014). "It's like We're One Big Family": Marginalized Young People, Community, and the Implications for Urban Schooling. School Community Journal, 24(2), 33. Retrieved from Questia.

Grantham, D. (2002). 17: Step-by-step approach to pedagogically based web design. In S. Fallows & R. Bhanot (Eds.), Educational development through information and communications technology (pp. 187–200). London, England: Kogan Page. Retrieved from Questia.

Grissmer, D., Flanagan, A., Kawata, J., & Williamson, S. (2000). *Improving student achievement: What state NAEP test scores tell us*. Santa Monica, CA: Rand. Retrieved from Questia.

Guy, R., & Marquis, G. (2016). The flipped classroom: A comparison of student performance using instructional videos and podcasts versus the lecture-based model of instruction. *Issues in Informing Science & Information Technology, 13*, 1. Retrieved from Questia.

Hargittai, E., & Hinnant, A. (2008). Digital inequality: Differences in young adults' use of the internet. *Communication Research*, *35*(5), 602–621.

Harrison, A. W., & Rainer, R. K. (1992). An examination of the factor structures and concurrent validates for the computer attitude scale, the computer anxiety rating scale, and the comp uter self-efficacy scale. *Educational and Psychological Measurement*, 52, 735-744.

Herrnstein, R. J., & Murray, C. (1994). *The bell curve*. New York, NY: Free Press.

Hohlfield, T. N., Ritzhaupt, A. D., Barron, A. E., & Kemker, K. (2008). Examining the digital divide in K-12 public schools: Four-year trends for supporting ICT literacy in Florida. *Computers & Education*, *51*(4), 1648–1663.

How Digital Literacy Is the Foundation of Academic Success. (2013, June). *District Administration, 49*(6). Retrieved from https://www.districtadministration.com/article/how-digital-literacy-foundation-academic-success

Howard, B., McGee, S., Schwartz, N., & Purcell, S. (2000). Experience of constructivism: Transforming teacher epistemology. *Journal of Research on Computing in Education*, *32*(4), 455–464.

International Society for Technology in Education (ISTE). (2016). *ISTE standards for students.* Retrieved from http://www.iste.org/standards/standards/

Internet World Stats. (2016, March 18). Retrieved from http://www.internetworldstats.com/

Irving, K. E. (2006). The Impact of Educational Technology on Student Achievement: Assessment of and for Learning. Science Educator, 15(1), 13. Retrieved from Questia.

Ito, M., Baumer, S., Bittandi, M., Boyd, D., Cody, R., Herr-Stephenson, B., & Horst, H.A. (2010). *Hanging out, messing around, and geeking out: Kids living and learning with new media.* Cambridge, MA: MIT Press.

Jenkins, H., Clinton, K., Purushotma, R., & Weigel, A. J. (2009). *Confronting the challenges of participatory culture: Media education for the 21st century.* Cambridge, MA: MIT Press.

Jonassen, D. H., Tessmer, M., & Hannum, W. H. (1999). *Task analysis methods for instructional design*. Mahwah, NJ: Lawrence Erlbaum Associates. Retrieved from Questia.

Kim, M. C., & Kim, J. K. (2001). Digital divide: Conceptual discussions and prospect. *Proceedings of Human Society and the Internet* (LNCS 2105), 78–91.

Krashen, S. (1982). *Principles and practice in second language acquisition.* New York, NY: Pergamon Press.

Krashen, S. D., & Tracy, D. T. (1982). *The natural approach: Language acquisition in the classroom.* Hayward, CA: Alemany Press.

Lovely, G., & Moberly, D. (2012). Pass It Forward: News Flash! Young Children like Technology! Early Childhood Programs Can Reinforce Safe and Appropriate Usage by Being Intentional with Their Policies and Instructional Practices. *T H E Journal (Technological Horizons In Education), 39*(8), 43. Retrieved from Questia.

Maier, A., & Youngs, P. (2009). Teacher preparation programs and teacher labor markets: How social capital may help explain teachers' career choices. *Journal of Teacher Education, 60*(4), 393. Retrieved from Questia.

Margolis, J., Estrella, R., Goode, J., Holme J., & Nao, K. (2008). *Stuck in the shallow end: Education: Education, race, and computing.* Cambridge, MA: MIT Press.

Martin, B. L., & Briggs, L. J. (1986). *The affective and cognitive domains: Integration for instruction and research*. Englewood Cliffs, NJ: Educational Technology.

Maslow, A. H. (1943). A theory of human motivation. *Psychology Review, 50*(4), 370–396.

McKinley, J. (2010). *Raising Black Students' achievement through culturally responsive teaching*. Alexandria, VA: ASCD. Retrieved from Questia.

McWhorter, J. H. (1997, Summer). Wasting energy on the illusion: Six months later. *The Black Scholar, 27*(2), 2.

Menon, N. (2015). Gender and Technology Use in Developing Countries: Evidence from Firms in Kenya. Journal of Economic Development, 40(3), 105. Retrieved from Questia.

Morgan, H. (2012). Poverty-stricken schools: What we can learn from the rest of the world and from successful schools in economically disadvantaged areas in the U.S. *Education, 133*(2), 291. Retrieved from Questia.

Mossberger, K. L., Tolbert, C. J., & Stansbury, M. (2003). *Virtual inequality: Beyond the digital divide*. Washington, DC: Georgetown University Press. Retrieved from Questia.

National Association for the Education of Young Children (NAEYC). (2009). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. Retrieved from www.naeyc.org/files/naeyc/file/positions/PSDAP.pdf

National Association for the Education of Young Children (NAEYC) and Fred Rogers Center for Early Learning and Children's Media (2012). *Technology and interactive media as tools in early childhood programs serving children from birth through age 8*. Retrieved from https://www.naeyc.org/sites/default/files/globally-shared/downloads/PDFs/resources/topics/PS_technology_WEB.pdf

National Center for Education Statistics (NCES). (2000). *Teachers' tools for the 21st century: A report on teachers' use of technology.* Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000102htm

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010a). *Common core state standards*. Washington, DC: Authors.

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010b). *Common core state standards for English language arts and literacy in history/social studies, science, and technical subjects*. Washington, DC: Authors.

National Research Council. (2010). *Report of a workshop on the scope and nature of computational thinking*. Washington, DC: National Academies Press.

New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review*, *66*, 60–92.

No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 6319 (2002).

Partnership for Assessment of Readiness for College and Careers (PARCC). (2015). PARCC college- and career-ready (CCR) determination policy and policy-level performance level descriptors (PLDs). Retrieved from http://parcc-assessment.org/content/uploads/2017/11/PARCCCCRDPolicyandPLDsFINAL.pdf

Perez, J., & Murray, M. C. (2010). Generativity: The New Frontier for Information and Communication Technology Literacy. Interdisciplinary Journal of Information, Knowledge and Management, 5, 127. Retrieved from Questia.

Piaget, J. (1970). *Genetic epistemology*. New York, NY: Columbia Press.

Pinkard, N., & Austin, K. (2009). Digital youth network: Creating new media citizens through the affinity learning model. *International Journal of Learning and Media, 4*(2). Retrieved from http://mitpressjournals.com/toc/ijlm/2/4

Pope, M., Hare, D., & Howard, E. (2002). Technology Integration: Closing the gap between what preservice teachers are taught to do and what they can do. *Journal of Technology and Teacher Education*, *10*(2), 191. Retrieved from Questia.

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9*(5), 1–6.

Prensky, M. (2005). Listen to the natives. *Educational Leadership*, *63*(4), 8–13.

Programme for International Student Assessment (PISA) & Organization for Economic Co-operation and Development (OECD). (2012). *Lessons from PISA 2012 for the USA*. Paris, France: OECD.

Programme for International Student Assessment (PISA) & Organization for Economic Co-operation and Development (OECD). (2015). *Key findings from PISA 2015 for the United States.* Retrieved from https://www.oecd.org/pisa/PISA-2015-United-States.pdf

Ritterband, V., & Heller, R. (2015, September 28). Competency education offers promise and peril for students. *Phi Delta Kappan, 97*(2). Retrieved from Questia.

Ritzhaupt, A. D., Liu, F., Dawson, K., & Barron, A. E. (2013). Differences in student information and communication technology literacy based on socio-economic status, ethnicity, and gender: Evidence of a digital divide in Florida schools. *Journal of Research on Technology in Education*, *45*(4), 291–307.

Robinson, R., & Xavier, S. (2007). The Role of Communication in Student Achievement. *Academic Exchange Quarterly, 11*(2), 21. Retrieved from Questia.

Roschelle, J. (1992). Learning by collaborating: Convergent conceptual change. *Journal of the Learning Sciences, 2*(1), 235–276.

Scheibe, C. (2004). A deeper sense of literacy: Curriculum-driven approaches to media literacy in the K-12 classroom. *American Behavioral Scientist, 48*(1), 60–68.

Siemens, G. (2005, January). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology & Distance Learning, 2*(1). Retrieved from http://www.itdl.org/Journal/Jan05/article01.htm

Simmons, T. (1999, December 27). Worlds apart: The racial education gap. *Raleigh News and Observer*.

Singham, M. (1998, September). The canary in the mine: The achievement gap between Black and White students. *Phi Delta Kappan, 80*(1), 8.

Spradlin, L. K., Welsh, L. A., & Hinson, S. L. (2000, Summer). Exploring African American academic achievement: Ogbu and Brookover perspectives. *Journal of African American Men, 5*(1), 17.

State of Louisiana Department of Education. (2015). *Student Enrollment & Demographics*. Retrieved from https://www.louisianabelieves.com/resources/library/enrollment-counts

State of Louisiana Department of Education. (2016). *Building digital literacy: Technology readiness by grade level.* Retrieved from https://www.louisianabelieves.com/docs/default-source/teacher-toolbox-resources/digital-literacy-guidance.pdf?sfvrsn=12

State of Louisiana Department of Education. (2017a). *2017 District Report Card.* Retrieved from https://www.louisianabelieves.com/data/reportcards/

State of Louisiana Department of Education. (2017b). *2017 School Report Cards.* Retrieved from https://www.louisianabelieves.com/data/reportcards/

State of Louisiana Department of Education. (2017c). *LEAP 2025 Assessment Guide for Grade 3 Mathematics*. Retrieved from https://www.louisianabelieves.com/resources/library/assessment-guidance

State of Louisiana Department of Education. (2017d). *LEAP 2025 Assessment Guide for Grade 3 Social Studies*. Retrieved from https://www.louisianabelieves.com/resources/library/assessment-guidance

State of Louisiana Department of Education. (2018). *Assessment Development Educator Review Committees.* Retrieved from https://www.louisianabelieves.com/docs/default-source/assessment-guidance/assessment-development-educator-review-committees.pdf?sfvrsn=4

Stewart, W. (2012, December 14). Dissemination or contamination? *Times Educational Supplement*, (5023). Retrieved from Questia.

Tavani, C. M., & Losh, S. C. (2003). Motivation, self-confidence, and expectations as predictors of the academic performances among our high school students. *Child Study Journal, 33*(3), 141. Retrieved from Questia.

Typing.com (n.d.). Retrieved from https://www.typing.com/teacher

U. S. Census Bureau. (2014). *Computer and internet use in the United States: 2013.* Retrieved from http://quickfacts.census.gov

U.S. Department of Education Office of Educational Technology. (2016). National education technology plan. Retrieved from http://tech.ed.gov/netp/

Vygotsky, L. S. (1978). *Mind in society.* Cambridge, MA: Harvard University Press.

Warschauer, M.  & Matuchniak, T. (2010). New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Review of Research in Education, 34*(1), 179–225.

Warschauer, M. (2003). *Technology and social inclusion: Rethinking the digital divide.* Cambridge, MA: MIT Press.

Wilson, B. (1996). *Constructivist learning environments*. Englewood Cliffs, NJ: Educational Technology.

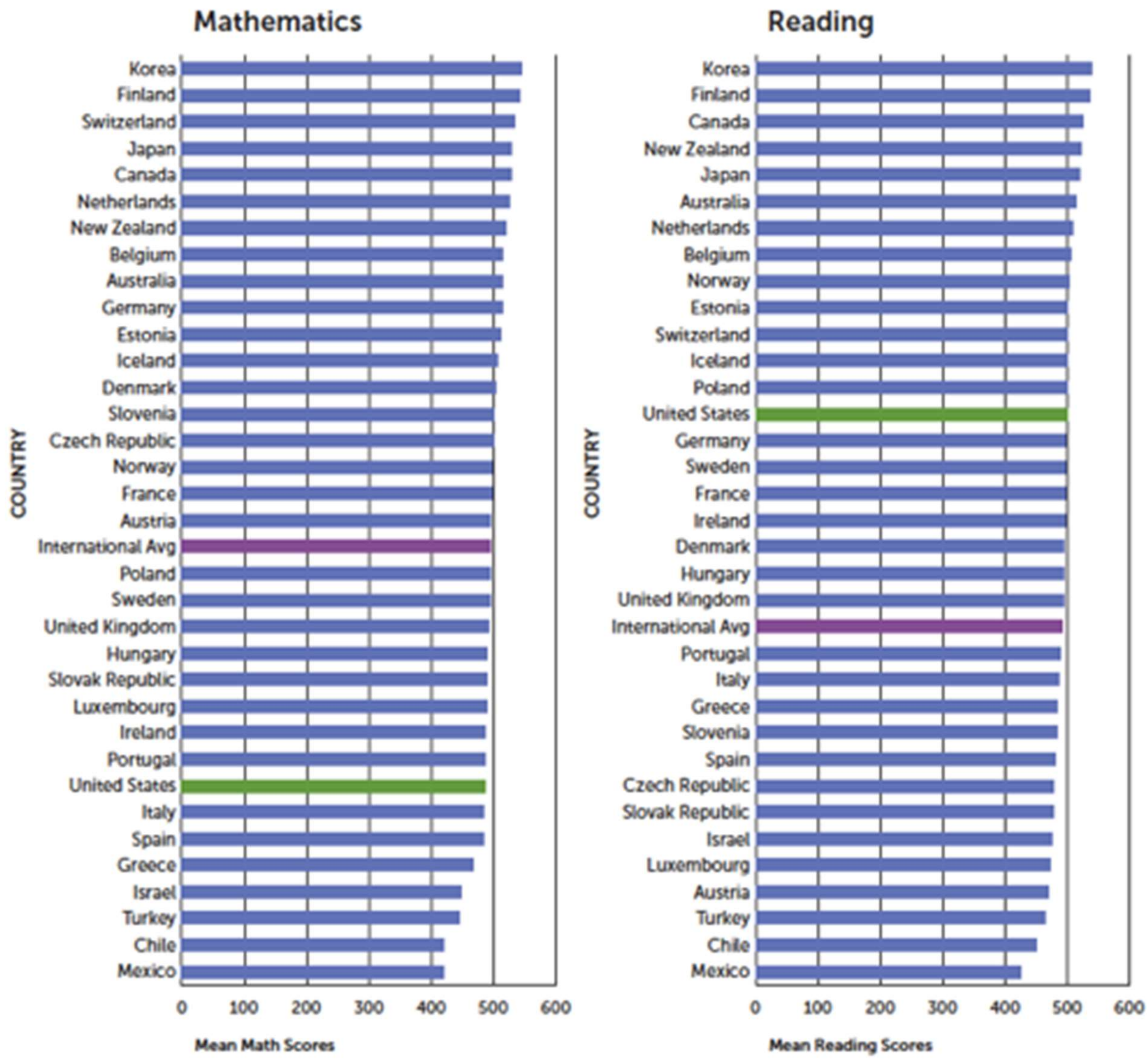
Wing, J. M. (2006). Computational thinking. *Communications of the ACM, 49*(3), 33–35.

Zhong, B., Wang, Q., Chen, J., & Li, Y. (2017). Investigating the period of switching roles in pair programming in a primary school. *Educational Technology & Society, 20*(3), 220. Retrieved from Questia.

# APPENDIX

**Appendix A**

**2012 PISA Mathematics and Reading Data** (PISA & OECD, 2012).



**Appendix B**

**Technology Readiness by Grade Level** (State of Louisiana Department of Education, 2016).

DEPARTMENT of EDUCATION
Louisiana Believes

TECHNOLOGY READINESS BY GRADE LEVEL

| DIGITAL LITERACY CATEGORIES | SKILLS | K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BASIC COMPUTER OPERATIONS | Identify basic terms and usage for technology systems (e.g., keyboard, mouse, word processing software, spreadsheets, etc.) | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Turn on a computer and login | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Use a pointing device, such as a mouse, to manipulate shapes and icons; click on URLs, radio buttons, and check boxes; and use scroll bars | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Use desktop icons, windows, and menus to open applications and documents | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Understand how to manage files and save documents | O | I | R | M | M | M | M | M | M | M | M | M | M |
| | Explain and use age-appropriate online tools and resources (e.g., tutorials, assessments, and web browsers) | | I | R | M | M | M | M | M | M | M | M | M | M |
| | Keyboarding<br>• Use proper posture and ergonomics<br>• Locate and use letter and number keys with correct left and right hand placement<br>• Locate and use correct finger for space bar, return key, and shift key<br>• Gain proficiency and speed in touch typing<br>• Demonstrate automatically in keyboarding skills by increasing accuracy and speed. (For students with disabilities, demonstrate alternate input techniques, as appropriate) | O | I | R | R | R | M | M | M | M | M | M | M | M |
| | Identify successful troubleshooting strategies for minor hardware and software issues or problems (e.g., frozen screen) | | | | I | R | M | M | M | M | M | M | M | M |
| | Independently operate peripheral equipment (e.g., scanner, digital camera) | | | | O | I | R | M | M | M | M | M | M | M |
| | Compress and expand large files | | | | | | | I | R | M | M | M | M | M |
| | Identify and use a variety of storage media and systems (e.g., optical disks, flash drives, networked storage, cloud services, etc.) and provide a rationale for using a certain medium for a specific purpose | | | | | | | I | R | M | M | M | M | M |
| | Identify and assess the capabilities and limitations of emerging technologies | | | | | | | I | R | M | M | M | M | M |

| LEGEND | O | I | R | M |
|---|---|---|---|---|
| | Optional at this grade level | Introduce the concept | Reinforce the concept | Master the concept |

2

| DIGITAL LITERACY CATEGORIES | SKILLS | K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WORD PROCESSING | Use a word processing application to write, edit, print, and save simple assignments | O | I | R | M | M | M | M | M | M | M | M | M | M |
| | Use menus and toolbar functions (e.g., font, style, line spacing, and margins) to format, edit, and print a document | | I | R | M | M | M | M | M | M | M | M | M | M |
| | Highlight text and copy and paste text | | O | I | R | M | M | M | M | M | M | M | M | M |
| | Copy and paste images within the document and from outside sources | | O | I | R | M | M | M | M | M | M | M | M | M |
| | Insert and size a graphic in a document | | O | I | R | M | M | M | M | M | M | M | M | M |
| | Proofread and edit writing using appropriate resources (e.g., dictionary, spell checker, grammar checker, and thesaurus) | | | I | R | M | M | M | M | M | M | M | M | M |
| | Demonstrate use of intermediate features in word processing applications (e.g., tabs, indents, headers and footers, endnotes, bulleted and numbered lists, and tables) | | | | | | I | R | M | M | M | M | M | M |
| | Apply advanced formatting and page layout features when appropriate (e.g., columns, templates, and styles) to improve the appearance of documents and materials | | | | | | | I | R | M | M | M | M | M |
| | Use the comment function in Review for peer editing of documents | | | O | I | R | M | M | M | M | M | M | M | M |
| | Use the Track Changes feature in Review for peer editing of documents | | | O | I | R | M | M | M | M | M | M | M | M |

| LEGEND | O | I | R | M |
|---|---|---|---|---|
| | Optional at this grade level | Introduce the concept | Reinforce the concept | Master the concept |

| DIGITAL LITERACY CATEGORIES | SKILLS | K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPREADSHEET (TABLES, CHARTS, AND GRAPHS) | Demonstrate an understanding of the spreadsheet as a tool to record, organize, graph, and analyze information | | | O | I | R | M | M | M | M | M | M | M | M |
| | Identify and explain terms and concepts related to spreadsheets (e.g., cell, column, row, values, labels, chart, graph, etc.) | | | O | I | R | M | M | M | M | M | M | M | M |
| | Use the auto-fill feature in a spreadsheet application | | | O | I | R | M | M | M | M | M | M | M | M |
| | Enter and edit data in spreadsheets | | | O | I | R | M | M | M | M | M | M | M | M |
| | Use mathematical symbols (i.e. +(add), -(subtract), *(multiply), /(divide), and ^(exponents)); perform calculations using formulas | | | | I | R | M | M | M | M | M | M | M | M |
| | Use spreadsheets and other applications to analyze data, make predictions, solve problems, draw conclusions, and propose solutions | | | | I | R | M | M | M | M | M | M | M | M |
| | Use spreadsheets to calculate, graph, organize, and present data in a variety of real-world settings and chose the most appropriate type to represent given data | | | | | | | I | R | M | M | M | M | M |
| | Use functions of a spreadsheet application (e.g. sort, filter, and find) | | | | | | | I | R | M | M | M | M | M |
| | Use various number formats (e.g. scientific notations, percentages, exponents) as appropriate | | | | | | | I | R | M | M | M | M | M |
| | Use advanced formatting features of a spreadsheet application (e.g. reposition columns and rows, add and name worksheets, color coding) | | | | | | | I | R | M | M | M | M | M |
| | Differentiate between formulas with absolute and relative cell references (i.e., formulas that remain constant or change when copied from one cell to another) | | | | | | | | | I | R | M | M | M |
| | Use multiple sheets within a workbook, and create links among worksheets to solve problems | | | | | | | | O | I | R | M | M | M |
| | Import and export data between spreadsheets and other applications | | | | | | | | O | I | R | M | M | M |

| LEGEND | O | I | R | M |
|---|---|---|---|---|
| | Optional at this grade level | Introduce the concept | Reinforce the concept | Master the concept |

| DIGITAL LITERACY CATEGORIES | SKILLS | K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATHEMATICAL APPLICATIONS | Draw two and three dimensional geometric shapes using a variety of technology tools | | | | | | | I | R | M | M | M | M | M |
| | Use and interpret scientific notations using a variety of technology applications | | | | | | | | | I | R | M | M | M |
| | Explain and demonstrate how specialized technology tools can be used for problem solving, decision making, and creativity in all subject areas (e.g. simulation software, environmental probes, computer aided design, geographic information systems, dynamic geometric software, and graphing calculators) | | | | | | | | I | R | M | M | M | M |
| PRESENTATION AND MULTIMEDIA TOOLS | Create, edit, and format text on a slide | | | I | R | M | M | M | M | M | M | M | M | M |
| | Create a series of slides and organize them to present research or convey an idea | | | | I | R | M | M | M | M | M | M | M | M |
| | Copy and paste or import graphics, resize them, and position them on a slide | | | | I | R | M | M | M | M | M | M | M | M |
| | Use painting and drawing tools and applications to create and edit work | | | I | R | M | M | M | M | M | M | M | M | M |
| | Watch online videos and use play, pause, rewind, and fast forward buttons while taking notes | O | I | R | M | M | M | M | M | M | M | M | M | M |
| | Create presentations for a variety of audiences and purposes with the use of appropriate transitions and animations to add interest | | | | | R | M | M | M | M | M | M | M | M |
| | Make strategic use of digital media to enhance understanding | | | | | | R | M | M | M | M | M | M | M |

| LEGEND | O | I | R | M |
|---|---|---|---|---|
| | Optional at this grade level | Introduce the concept | Reinforce the concept | Master the concept |

| DIGITAL LITERACY CATEGORIES | SKILLS | K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ACCEPTABLE USE, COPYRIGHT, PLAGIARISM, AND ONLINE SAFETY | Explain and demonstrate compliance with classroom and school rules (Acceptable Use Policy) regarding responsible use of computers and networks | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Explain responsible uses of technology and digital information and describe possible consequences of inappropriate use | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Explain Fair Use guidelines for the use of copyrighted materials (e.g. text, images, audio, and video in student projects) and giving credit to media creators | | | | I | R | M | M | M | M | M | M | M | M |
| | Identify and explain the strategies for the safe and efficient use of computers (e.g., password, virus protection software, spam filters, and pop-up blockers) | | I | R | M | M | M | M | M | M | M | M | M | M |
| | Demonstrate safe email practices, recognition of the potential public exposure of email, and appropriate email etiquette | | | | I | R | M | M | M | M | M | M | M | M |
| | Identify cyber-bullying and describe strategies to deal with such a situation | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Recognize and describe the potential risks and dangers associated with various forms of online communications | | I | R | M | M | M | M | M | M | M | M | M | M |
| | Comply with the district's Acceptable Use Policy related to ethical use, cyber-bullying, privacy, plagiarism, spam, viruses, hacking, and file sharing | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Analyze and explain how media and technology can be used to distort, exaggerate, and misrepresent information | | | | | | | I | R | M | M | M | M | M |
| | Give examples of hardware and applications that enable people with disabilities to use technology | | | | | | | I | R | M | M | M | M | M |
| | Explain the possible risks associated with the use of networked digital environments (e.g. Internet, mobile phones, wireless, and LANs and WANs) and sharing personal information | | I | R | M | M | M | M | M | M | M | M | M | M |

| LEGEND | O | I | R | M |
|---|---|---|---|---|
| | Optional at this grade level | Introduce the concept | Reinforce the concept | Master the concept |

| DIGITAL LITERACY CATEGORIES | SKILLS | K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RESEARCH AND INFORMATION GATHERING | Use age-appropriate technologies to locate, collect, and organize content from media collection activities for specific purposes, citing sources | | | O | I | R | R | M | M | M | M | M | M | M |
| | Perform basic searches on databases (e.g. library, card catalog, encyclopedia) to locate information | | | O | I | R | M | M | M | M | M | M | M | M |
| | Evaluate teacher- or self- selected Internet resources in terms of their usefulness for research | | | I | R | M | M | M | M | M | M | M | M | M |
| | Use content specific technology tools (e.g., environmental probes, sensors, measuring devices, and simulations) to gather and analyze data | | | O | I | R | M | M | M | M | M | M | M | M |
| | Use Web 2.0 tools (e.g., online discussions, blogs, and wikis) to gather and share information | | | | O | I | R | M | M | M | M | M | M | M |
| | Identify probable types and locations of websites by examining their domain extensions (e.g. .edu, .com, .org, .gov, .au) | | | | | | | I | R | M | M | M | M | M |
| | Use effective search strategies for locating and retrieving electronic information (e.g. using syntax and Boolean logic operators) | | | | | | | R | M | M | M | M | M | M |
| | Use search engines and online directories and explain the differences among various search engines and how they rank results | | | | | | | I | R | M | M | M | M | M |
| | Use appropriate academic language in online learning environments (e.g., post, thread, intranet, discussion forum, drop box, account, and password) | | | | | | | I | R | M | M | M | M | M |
| | Explain how technology can support communication and collaboration, personal and professional productivity, and lifelong learning | | | | | | | I | R | M | M | M | M | M |
| | Write correct in-text citations and reference lists for text and images gathered from electronic sources | | | | | | | I | R | M | M | M | M | M |
| | Use web browsing to access information (e.g., enter a URL, access links, create bookmarks and favorites, print webpages) | | | O | I | R | M | M | M | M | M | M | M | M |
| | Develop and/or use teacher-developed guidelines to evaluate the content, organization, design, use of citations, and presentation of technologically enhanced projects | | | | | | | I | R | M | M | M | M | M |

| LEGEND | O | I | R | M |
|---|---|---|---|---|
| | Optional at this grade level | Introduce the concept | Reinforce the concept | Master the concept |

| DIGITAL LITERACY CATEGORIES | SKILLS | K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COMMUNICATION AND COLLABORATION | Work collaboratively online with other students under teacher supervision | | | | | I | R | M | M | M | M | M | M | M |
| | Use a variety of age-appropriate technologies (e.g., drawing program or presentation software) to communicate and exchange ideas | I | R | M | M | M | M | M | M | M | M | M | M | M |
| | Create projects that use text and various forms of graphics and audio | | | I | R | M | M | M | M | M | M | M | M | M |
| | Create projects that use text and various forms of graphics, audio, and video | | | O | I | R | M | M | M | M | M | M | M | M |
| | Use a variety of district approved Web 2.0 tools (e.g., e-mail discussion groups, blogs, etc.) to collaborate and communicate with peers, experts, and other audiences using grade-appropriate academic language | | | | O | I | R | M | M | M | M | M | M | M |
| | Use a variety of media to present information for specific purposes (e.g., reports, research papers, presentations, newsletters, Web sites, podcasts, and blogs), citing sources. | | | | | | | R | M | M | M | M | M | M |
| | Demonstrate how the use of various techniques and effects (e.g. editing, music, color, and rhetorical devices) can be used to convey meaning in media | | | | | | | I | R | M | M | M | M | M |
| | Plan and implement a collaborative project with students in other classrooms and schools using telecommunications tools (e.g., e-mail, discussion forums, groupware, interactive Web sites, and video conferencing) | | | | | I | R | M | M | M | M | M | M | M |

| LEGEND | O | I | R | M |
|---|---|---|---|---|
| | Optional at this grade level | Introduce the concept | Reinforce the concept | Master the concept |

## Appendix C

### ISTE Standards for Students

(International Society for Technology in Education, 2016).

### NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS AND PERFORMANCE INDICATORS (NETS)

**NETS for Students (NETS.S)**

**1. Creativity and Innovation**- Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:

A. apply existing knowledge to generate new ideas, products, or processes.
B. create original works as a means of personal or group expression.
C. use models and simulations to explore complex systems and issues.
D. identify trends and forecast possibilities.

**2. Communication and Collaboration**- Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students:

A. interact, collaborate, & publish with peers, experts, others employing a variety of digital environments & media.
B. communicate information and ideas effectively to multiple audiences using a variety of media & formats.
C. develop cultural understanding and global awareness by engaging with learners of other cultures.
D. contribute to project teams to produce original works or solve problems.

**3. Research and Information Fluency**- Students apply digital tools to gather, evaluate, and use information. Students:

A. plan strategies to guide inquiry.
B. locate, organize, analyze, evaluate, synthesize, & ethically use information from a variety of sources and media.
C. evaluate & select information sources and digital tools based on the appropriateness to specific tasks.
D. process data and report results.

**4. Critical Thinking, Problem Solving, and Decision Making**- Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students:

A. identify and define authentic problems and significant questions for investigation.
B. plan and manage activities to develop a solution or complete a project.
C. collect and analyze data to identify solutions and/or make informed decisions.
D. use multiple processes and diverse perspectives to explore alternative solutions.

**5. Digital Citizenship**- Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students:

A. advocate and practice safe, legal, and responsible use of information and technology.
B. exhibit a positive attitude toward using technology that supports collaboration, learning, & productivity.
C. demonstrate personal responsibility for lifelong learning.
D. exhibit leadership for digital citizenship.

**6. Technology Operations and Concepts -** Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:

A. understand and use technology systems.
B. select and use applications effectively and productively.
C. troubleshoot systems and applications.
D. transfer current knowledge to learning of new technologies.

## Appendix D

## Typing.com Intervention Schedule (n.d.)

The intervention group progressed through the following Typing.com (n.d.) keyboarding lessons during the digital literacy intervention:

Lesson 1: J, F, and Space

Lesson 2: U, R, and K Keys

Lesson 3: D, E, and I Keys

Lesson 4: C, G, and N Keys

Lesson 5: Beginner Review 1

Lesson 6: T, S, and L Keys

Lesson 7: O, B, and A Keys

Lesson 8: V, H, and M Keys

Lesson 9: Period and Comma

Lesson 10: Beginner Review 2

Lesson 11: W, X, and; Keys

Lesson 12: Q, Y, and P Keys

Lesson 13: Z and Enter Keys

Lesson 14: Beginner Wrap-Up

**Appendix E**

**Code.org Course C Curriculum (n.d.)**

**Modules 1: Programming in Maze**
Programming | Algorithms | Maze | Sequencing
**Overview**

Featuring characters from the game Angry Birds, students will develop sequential algorithms to move a bird from one side of the maze to the pig at the other side. To do this they will stack code blocks together in a linear sequence to move straight, turn left, or turn right.

**Purpose**

In this lesson, students will be practicing their debugging and programming skills on a computer platform. When someone starts *programming*, they piece together instructions in a specific order using something that a machine can read. Through the use of programming, students will develop an understanding of how a computer navigates instructions and order.

**Objectives**
**Students will be able to:**

a. Express movement as a series of commands.
b. Order movement commands as sequential steps in a program.
c. Represent an algorithm as a computer program.
d. Count the number of times an action should be executed and represent it as instructions in a program.

**Vocabulary**

a. **Algorithm** - A list of steps to finish a task.
b. **Bug** - Part of a program that does not work correctly.
c. **Debugging** - Finding and fixing problems in an algorithm or program.
d. **Sequencing** - Putting commands in correct order so computers can read the commands.

**Previewing Online Puzzles as a Class**

Pull up the online puzzles and choose a puzzle to do in front of the class. We recommend puzzle 8 for its difficulty. While working through this puzzle with the class, voice your frustrations and talk about persistence. Refer back to the "Building a Foundation" activity. That was frustrating because of the limitations. How did you incorporate them? What are your limitations here? What can you do to embrace those limitations and solve this problem?

Once you have worked through the puzzle with the class. Ask the students to reflect on the hard parts.

**Ask:**

- What made that puzzle difficult?
- What did I do when I was frustrated?

**Main Activity (30 min)**
**Course C Online Puzzles - Website**

Teachers play a vital role in computer science education and supporting a collaborative and vibrant classroom environment. During online activities, the role of the teacher is primarily one of encouragement and support. Online lessons are meant to be student-centered, so teachers should avoid stepping in when students get stuck. Some ideas on how to do this are:

- Utilize Pair Programming - Student Video whenever possible during the activity.
- Encourage students with questions/challenges to start by asking their partner.
- Unanswered questions can be escalated to a nearby group, who might already know the solution.
- Remind students to use the debugging process before you approach.
- Have students describe the problem that they're seeing. What is it supposed to do? What does it do? What does that tell you?
- Remind frustrated students that frustration is a step on the path to learning, and that persistence will pay off.
- If a student is still stuck after all of this, ask leading questions to get the student to spot an error on their own.

**Standards Alignment**
**PARCC / Smarter Balanced Assessment Skills**

E. Click / tap
F. Drag and drop
G. Select object
H. Use video player

**ISTE Standards (formerly NETS)**

K. 1.a - Apply existing knowledge to generate new ideas, products, or processes.
L. 1.c - Use models and simulation to explore complex systems and issues.
M. 4.b - Plan and manage activities to develop a solution or complete a project.
N. 6.a - Understand and use technology systems.

O. 6.c - Troubleshoot systems and applications.
P. 6.d - Transfer current knowledge to learning of new technologies.

**CSTA K-12 Computer Science Standards**

a. CT.L1:3-01. Use technology resources (e.g., puzzles, logical thinking programs) to solve age appropriate problems.
b. CL.L1:3-02. Work cooperatively and collaboratively with peers teachers, and others using technology.
c. CPP.L1:6-05. Construct a program as a set of step-by-step instructions to be acted out.
d. CPP.L1:6-06. Implement problem solutions using a block-based visual programming language.
e. CT.L2-01. Use the basic steps in algorithmic problem solving to design solutions.
f. CT.L2-06. Describe and analyze a sequence of instructions being followed.
g. CT.L2-08. Use visual representations of problem states, structures, and data.
h. CT.L2-12. Use abstraction to decompose a problem into sub problems.

**Next-Gen Science Standards**

a. 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**Common Core Mathematical Practices**

a. 1. Make sense of problems and persevere in solving them.
b. 2. Reason abstractly and quantitatively.
c. 5. Use appropriate tools strategically.
d. 6. Attend to precision.
e. 7. Look for and make use of structure.
f. 8. Look for and express regularity in repeated reasoning.

**Common Core Math Standards**

a. 3.OA.3 - Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities.
b. 4.NBT.B.4 - Fluently add and subtract multi-digit whole numbers using the standard algorithm.
c. 5.NBT.B.5 - Fluently multiply multi-digit whole numbers using the standard algorithm.

## Module 2-3: Debugging in Maze

**Debugging | Bug | Maze**

**Overview**

Debugging is an essential element of learning to program. In this lesson, students will encounter puzzles that have been solved incorrectly. They will need to step through the existing code to identify errors, including incorrect loops, missing blocks, extra blocks, and blocks that are out of order.

**Purpose**

Students in your class might become frustrated with this lesson because of the essence of debugging. *Debugging* is a concept that is very important to computer programming. Computer scientists have to get really good at facing the bugs in their own programs. Debugging forces the students to recognize problems and overcome them while building critical thinking and problem-solving skills.

**Objectives**

**Students will be able to:**

- Predict where a program will fail.
- Modify an existing program to solve errors.
- Reflect on the debugging process in an age-appropriate way.

**Vocabulary**

- **Bug** - Part of a program that does not work correctly.
- **Debugging** - Finding and fixing problems in an algorithm or program.

**Vocabulary**

This lesson has three new and important vocabulary words:

- ***Bug*** - Say it with me - Buhh-g. Something that is going wrong. An error.
- ***Debugging*** - Say it with me: Dee-bug-ing. To find and fix errors.
- ***Persistence*** - Say it with me: Purr-siss-tense. Not giving up. Persistence works best when you try things many different ways, many different times.

**Say:**

Debugging is a process. First, you must recognize that there is an error in your program. You then work through the program step by step to find the error. Try the first step, did it work? Then the second, how about now? If you make sure that everything is working line by line, then when you get to the place that your code isn't doing what it's supposed to, you know that you've found a bug. Once you've discovered your bug, you can work to fix (or "debug") it!

If you think it will build excitement in the class you can introduce the character of today's puzzles, Scrat from Ice Age. If students aren't familiar with Scrat, show some videos of the quirky squirrel running into trouble.

**Module 2 Main Activity (30 min)**
**Course C Online Puzzles - Website**

Before letting the students start on the computer, introduce them to the advantages of Pair Programming - Student Video and asking their peers for help. Sit students in pairs and recommend they ask at least two peers for help before they come to a teacher.

Practice as Driver and Navigator

**Module 3: Main Activity**

As mentioned in the purpose of this lesson, make sure the students are aware that they will face frustrating puzzles. Tell them it is okay to feel frustrated, but it is important to work through the problem and ask for help. As the students work through the puzzles, walk around to make sure no student is feeling so stuck that they aren't willing to continue anymore.

**Standards Alignment**
**PARCC / Smarter Balanced Assessment Skills**

- Click / tap
- Drag and drop
- Select object
- Use video player

**ISTE Standards (formerly NETS)**

- 1.a - Apply existing knowledge to generate new ideas, products, or processes.
- 1.c - Use models and simulation to explore complex systems and issues.
- 4.b - Plan and manage activities to develop a solution or complete a project.
- 6.a - Understand and use technology systems.
- 6.c - Troubleshoot systems and applications.
- 6.d - Transfer current knowledge to learning of new technologies.

**Next-Gen Science Standards**

- K-2-PS3-2. Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**Common Core Mathematical Practices**

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.

**Common Core Language Arts Standards**

- SL.3.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
- L.3.6 - Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.

**Module 4: Programming in Collector**
**Collector | Program | Programming**
**Overview**

In this series of puzzles, students will continue to develop their understanding of algorithms and debugging. With a new character, Laurel the Adventurer, students will create sequential algorithms to get Laurel to pick up treasure as she walks along a path.

**Purpose**

In this lesson, students will be practicing their programming skills using a new character, Laurel the Adventurer. When someone starts *programming* they piece together instructions in a specific order using something that a machine can read. Through the use of programming, students will develop an understanding of how a computer navigates instructions and order. Using a new character with a different puzzle objective will help students widen their scope of experience with sequencing and algorithms in programming.

**Objectives**
**Students will be able to:**

- Order movement commands as sequential steps in a program.
- Represent an algorithm as a computer program.
- Develop problem solving and critical thinking skills by reviewing debugging practices.

**Vocabulary**

- **Algorithm** - A list of steps to finish a task.
- **Program** - An algorithm that has been coded into something can be run by a machine.
- **Programming** - The art of creating a program.

**Previewing Online Puzzles as a Class**

Pull a puzzle from the corresponding online stage. We recommend puzzle 7. Have students discuss a pattern that they think will get Laurel the Adventurer to collect all the treasure. Ask the students to share. See how many other students had the same answer!

**Main Activity (30 min)**
**Course C Online Puzzles - Website**

Laurel the Adventurer is looking to collect as much treasure as she can. Instruct the students to traverse the puzzle to collect whatever they can. Some levels will require you to only pick up one piece of treasure, but others will require you to pick up every piece of treasure. Pay attention to the instructions to know what to do!

**Standards Alignment**
**PARCC / Smarter Balanced Assessment Skills**

- Click / tap
- Drag and drop
- Select object
- Use video player

**ISTE Standards (formerly NETS)**

- 1.a - Apply existing knowledge to generate new ideas, products, or processes.
- 1.c - Use models and simulation to explore complex systems and issues.
- 4.b - Plan and manage activities to develop a solution or complete a project.
- 6.a - Understand and use technology systems.
- 6.c - Troubleshoot systems and applications.
- 6.d - Transfer current knowledge to learning of new technologies.

**Next-Gen Science Standards**

- K-2-PS3-2. Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**Common Core Mathematical Practices**

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.

**Common Core Language Arts Standards**

- SL.3.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
- L.3.6 - Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.

## Module 5: Programming in Artist

Artist | Sequencing

**Overview**

In this lesson, students will take control of the Artist to complete drawings on the screen. This Artist stage will allow students to create images of increasing complexity using new blocks like move forward by 100 pixels and turn right by 90 degrees.

**Purpose**

Building off of the students' previous experience with sequencing, this lesson will work to inspire more creativity with coding. The purpose of this lesson is to solidify knowledge on sequencing by introducing new blocks and goals. In this case, students learn more about pixels and angles using the new blocks, while still practicing their sequencing skills. Also, students will be able to visualize new goals such as coding the Artist to draw a square.

**Objectives**

**Students will be able to:**

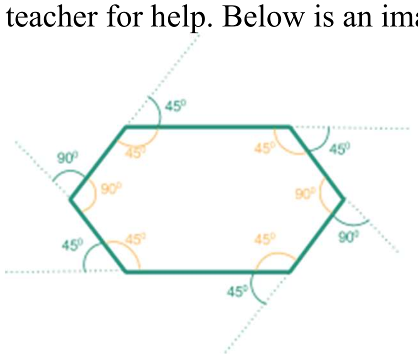
- Create a program to complete an image using sequential steps.
- Break complex shapes into simple parts.

**Main Activity (30 min)**

**Course C Online Puzzles - Website**

In this set of puzzles, the artist will no longer be constrained to 90 degree angles. Having physical protractors available can be help students better visualize the angles they need. Otherwise, the stage provides images of the angles as the student selects which angle to use. (Please note: Angle choices are limited to two inside of the dropdown menu, reducing the number of options students have to work through.)

The eighth puzzle asks the students to draw a 6 sided polygon. This might be challenging for some students. We recommend getting the students to try a few times, ask a peer, then ask the teacher for help. Below is an image that might be helpful for the students.



**Standards Alignment**
Common Core English Language Arts Standards
L - Language

- 2.L.6 - Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using adjectives and adverbs to describe (e.g., When other kids are happy that makes me happy).

SL - Speaking & Listening

- 2.SL.1 - Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

Common Core Math Standards
G - Geometry

- 2.G.1 - Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.5 Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

MP - Math Practices

- MP.1 - Make sense of problems and persevere in solving them
- MP.2 - Reason abstractly and quantitatively
- MP.4 - Model with mathematics
- MP.5 - Use appropriate tools strategically
- MP.6 - Attend to precision
- MP.7 - Look for and make use of structure
- MP.8 - Look for and express regularity in repeated reasoning

OA - Operations And Algebraic Thinking

- 2.OA.1 - Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations.

CSTA K-12 Computer Science Standards
AP - Algorithms & Programming

- 1A-AP-09 - Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- 1A-AP-11 - Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.
- 1A-AP-14 - Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.

Next Generation Science Standards
ETS - Engineering in the SciencesETS1 - Engineering Design

**Module 6: Loops with Rey and BB-8**

**Loops | Maze**

**Overview**

Building on the concept of repeating instructions from "Getting Loopy," this stage will have students using loops to help BB-8 traverse a maze more efficiently than before.

**Purpose**

In this lesson, students will be learning more about *loops* and how to implement them in Blockly code. Using *loops* is an important skill in programming because manually repeating commands is tedious and inefficient. With the Code.org puzzles, students will learn to add instructions to existing loops, gather repeated code into loops, and recognize patterns that need to be looped. It should be noted that students will face puzzles with many different solutions. This will open up discussions on the various ways to solve puzzles with advantages and disadvantages to each approach.

**Objectives**

**Students will be able to:**

- Identify the benefits of using a loop structure instead of manual repetition.
- Break down a long sequence of instructions into the largest repeatable sequence.
- Employ a combination of sequential and looped commands to reach the end of a maze.

**Vocabulary**

- **Loop** - The action of doing something over and over again.
- **Repeat** - Do something again

**Main Activity (30 min)**

**Course C Online Puzzles - Website**

As students work through the puzzles, see if they can figure out how many blocks they use with a loop vs. not using a loop. Pair Programming - Student Video works really well with this set of puzzles because there are a few ways to fill the loops. Push for friendly discussion between pairs in instances of disagreement on how to solve the puzzle. Have the students ask each other questions like:

- How did you come up with that solution?
- What are some benefits of solving the puzzle that way?

**Standards Alignment**
**PARCC / Smarter Balanced Assessment Skills**

- Click / tap
- Drag and drop
- Select object
- Use video player

**ISTE Standards (formerly NETS)**

- 1.a - Apply existing knowledge to generate new ideas, products, or processes.
- 1.c - Use models and simulation to explore complex systems and issues.
- 4.b - Plan and manage activities to develop a solution or complete a project.
- 6.a - Understand and use technology systems.
- 6.c - Troubleshoot systems and applications.
- 6.d - Transfer current knowledge to learning of new technologies.

**Next-Gen Science Standards**

- K-2-PS3-2. Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**Common Core Mathematical Practices**

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.

**Common Core Language Arts Standards**

- SL.3.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
- L.3.6 - Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.

## Module 7: Loops in Artist

**Loop | Artist**

**Overview**

Watch student faces light up as they make their own gorgeous designs using a small number of blocks and digital stickers! This lesson builds on the understanding of loops from previous lessons and gives students a chance to be truly creative. This activity is fantastic for producing artifacts for portfolios or parent/teacher conferences.

**Purpose**

This series highlights the power of loops with creative and personal designs.

Offered as a project-backed sequence, this progression will allow students to build on top of their own work and create amazing artifacts.

**Objectives**

**Students will be able to:**

- Identify the benefits of using a loop structure instead of manual repetition.
- Differentiate between commands that need to be repeated in loops and commands that should be used on their own.

**Vocabulary**

- **Loop** - The action of doing something over and over again.
- **Repeat** - Do something again

**Main Activity (30 min)**

**Course C Online Puzzles - Website**

Some students may discover where to add repeat loops by writing out the program without loops then circling sections of repetitions. If the students in your class seem like they could benefit from this, have them keep paper and pencils beside them at their machines. Students might also enjoy drawing some of the shapes and figures on paper before they program it online. (When drawing stamps, it can be easier to symbolize those with simple shapes like circles and squares.)

**Standards Alignment**

**PARCC / Smarter Balanced Assessment Skills**

- Click / tap

- Drag and drop
- Select object
- Use video player

**ISTE Standards (formerly NETS)**

- 1.a - Apply existing knowledge to generate new ideas, products, or processes.
- 1.c - Use models and simulation to explore complex systems and issues.
- 4.b - Plan and manage activities to develop a solution or complete a project.
- 6.a - Understand and use technology systems.
- 6.c - Troubleshoot systems and applications.
- 6.d - Transfer current knowledge to learning of new technologies.

**Next-Gen Science Standards**

- K-2-PS3-2. Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**Common Core Mathematical Practices**

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.

**Common Core Language Arts Standards**

- SL.3.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
- L.3.6 - Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.

## Module 8: Loops in Harvester

Loops | Harvester

**Overview**

In the preceding stage, students used loops to create fantastic drawings. Now they're going to loop new actions in order to help the harvester collect multiple veggies growing in large bunches.

**Purpose**

It may seem unnecessarily repetitive to have two plugged stages introducing loops, but the practice of using loops for different reasons develops a student's understanding of what loops can do. In "Loops in Maze" students only used loops to repeat movements. In this lesson, students will use loops to repeat other actions like harvesting pumpkins. New patterns will emerge and students will use creativity and logical thinking to determine what code needs to be repeated and how many times.

**Objectives**

**Students will be able to:**

- Write a program for a given task which loops a single command.
- Identify when a loop can be used to simplify a repetitive action.
- Employ a combination of sequential and looped commands to move and perform actions.

**Vocabulary**

1. Loop - The action of doing something over and over again.
2. Repeat - Do something again

**Main Activity (30 min)**

Course C Online Puzzles - Website

When students are using loops to repeat an action (such as harvesting pumpkins), encourage them to think about the movements before and after that action. Could those actions be brought into the loop as well?

Common Core English Language Arts Standards

L - Language

1. 2.L.6 - Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using adjectives and adverbs to describe (e.g., When other kids are happy that makes me happy).

SL - Speaking & Listening

- 2.SL.1 - Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

Common Core Math Standards

MP - Math Practices

- MP.1 - Make sense of problems and persevere in solving them
- MP.2 - Reason abstractly and quantitatively
- MP.4 - Model with mathematics
- MP.5 - Use appropriate tools strategically
- MP.6 - Attend to precision
- MP.7 - Look for and make use of structure
- MP.8 - Look for and express regularity in repeated reasoning

OA - Operations And Algebraic Thinking

- 2.OA.1 - Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations.

CSTA K-12 Computer Science Standards

AP - Algorithms & Programming

- 1A-AP-09 - Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- 1A-AP-10 - Develop programs with sequences and simple loops, to express ideas or address a problem.
- 1A-AP-11 - Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.
- 1A-AP-14 - Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.

**Module 9: Build a Flappy Game**

**Flappy | Event**

**Overview**

In this special stage, students get to build their own Flappy Bird game by using event handlers to detect mouse clicks and object collisions. At the end of the level, students will be able to customize their game by changing the visuals or rules.

**Purpose**

Events are very common in computer programs. In this lesson, students will further develop their understanding of events by making a Flappy Bird game. Students will learn to make their character move across the screen, make noises, and react to obstacles based on user-initiated events.

**Objectives**

**Students will be able to:**

- Match blocks with the appropriate event handler.
- Create a game using event handlers.
- Share a creative artifact with other students.

**Vocabulary**

- **Event** - An action that causes something to happen.

**Main Activity (30 min)**

**Course C Online Puzzles - Website**

In the final stage of this lesson students are able to tweak their game to make it unique - encourage them to see how different they can make each game within the constraints provided. If the class doesn't use Pair Programming - Student Video, then tell students to go around and look at other student's games. Otherwise, have students discuss and try out different ways to set up their game with their partner.

*Teacher Tip*

*Remind the students to only share their work with their close friends or family. For more information watch or show the class Pause and Think Online - Video.*

**Standards Alignment**

**PARCC / Smarter Balanced Assessment Skills**

- Click / tap
- Drag and drop
- Select object
- Use video player

**ISTE Standards (formerly NETS)**

- 1.a - Apply existing knowledge to generate new ideas, products, or processes.
- 1.c - Use models and simulation to explore complex systems and issues.
- 4.b - Plan and manage activities to develop a solution or complete a project.
- 6.a - Understand and use technology systems.
- 6.c - Troubleshoot systems and applications.
- 6.d - Transfer current knowledge to learning of new technologies.

**Next-Gen Science Standards**

- K-2-PS3-2. Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**Common Core Mathematical Practices**

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.

**Common Core Language Arts Standards**

- SL.3.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
- L.3.6 - Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.

**Lesson 10: Events in Play Lab**

**Play Lab | Event**

**Overview**

In this online activity, students will have the opportunity to learn how to use events in Play Lab and to apply all the coding skills they've learned to create an animated game. It's time to get creative and make a game in Play Lab!

**Purpose**

Here, students will further develop their understanding of events using Play Lab. Students will use events to make characters move around the screen, make noises, and change backgrounds based on user input. At the end of the puzzle sequence, students will be presented with the opportunity to share their projects.

**Objectives**

**Students will be able to:**

- Create an animated, interactive game using sequence and event-handlers.
- Identify actions that correlate to input events.

**Vocabulary**

- **Event** - An action that causes something to happen.

**Main Activity (30 min)**

Remind the students to only share their work with their close friends or family. For more information watch or show the class Pause and Think Online - Video.

**Course C Online Puzzles - Website**
This is the most free-form online activity of the course. At the final stage students have the freedom to create a game of their own. You may want to provide structured guidelines around what kind of game to make, particularly for students who are overwhelmed by too many options.

**Standards Alignment**

**PARCC / Smarter Balanced Assessment Skills**

- Click / tap
- Drag and drop
- Select object
- Use video player

**ISTE Standards (formerly NETS)**

- 1.a - Apply existing knowledge to generate new ideas, products, or processes.
- 1.c - Use models and simulation to explore complex systems and issues.
- 4.b - Plan and manage activities to develop a solution or complete a project.
- 6.a - Understand and use technology systems.
- 6.c - Troubleshoot systems and applications.
- 6.d - Transfer current knowledge to learning of new technologies.

**Next-Gen Science Standards**

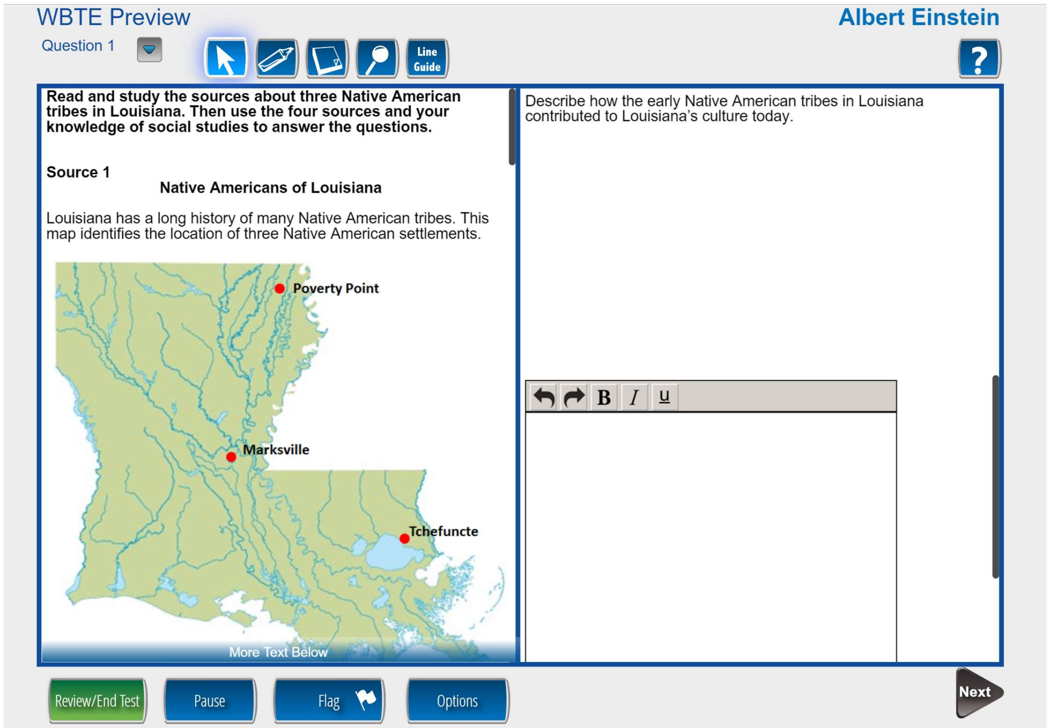
- K-2-PS3-2. Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

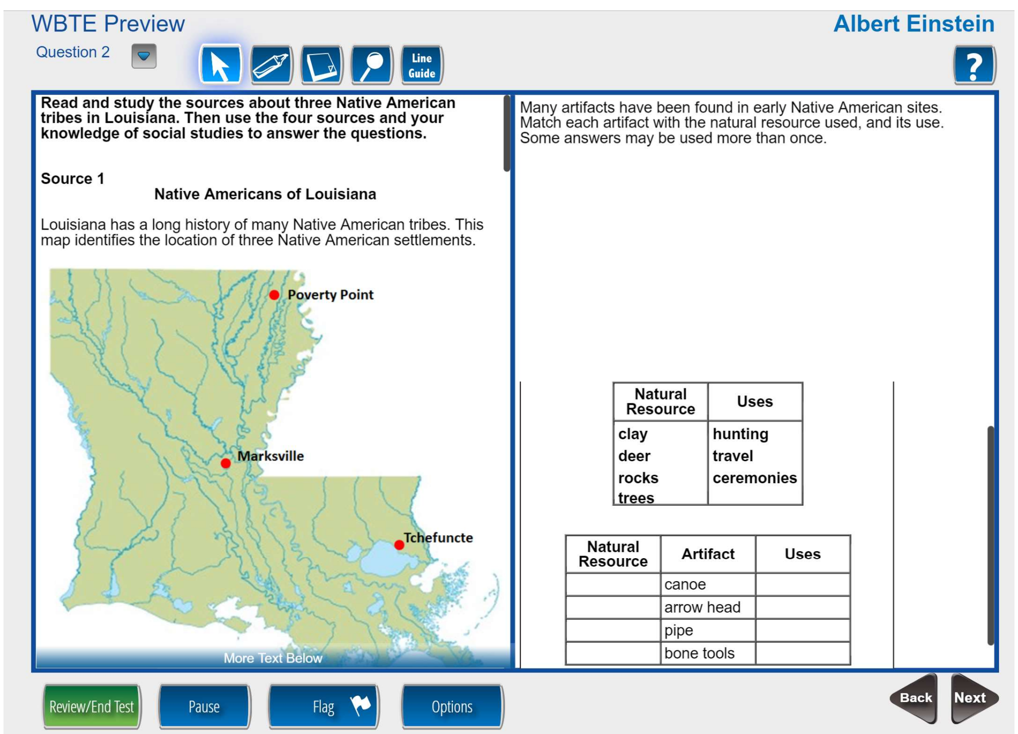
**Common Core Mathematical Practices**

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.

# Appendix F:

## **EAGLE 2.0 CBT–Social Studies Grade 3 Assessment** (DRC, 2017b)



WBTE Preview **Albert Einstein**

Question 3

Line Guide

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.


More Text Below

What would be the **best** use for the map in Source 1?

ⓐ to locate where some early Native Americans lived

ⓑ to find where Mt. Driskill is located

ⓒ to learn what early Native Americans ate

ⓓ to travel across Louisiana by water

Review/End Test Pause Flag Options Back Next

WBTE Preview **Albert Einstein**

Question 4

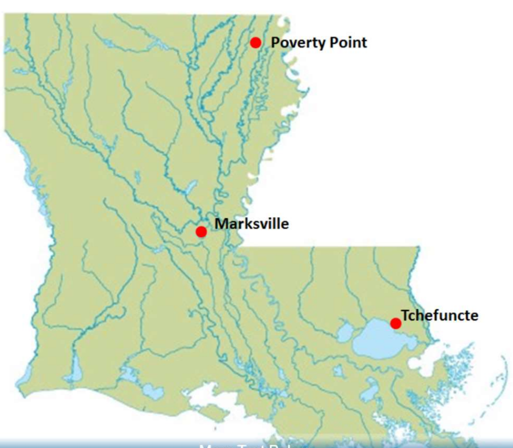
Line Guide

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.




More Text Below

Which statement tells the directions needed when traveling from the Tchefuncte site to Poverty Point?

ⓐ first north, then south

ⓑ first south, then west

ⓒ first west, then north

ⓓ first east, then south

Review/End Test Pause Flag Options Back Next

WBTE Preview

**Albert Einstein**

Question 5

Line Guide

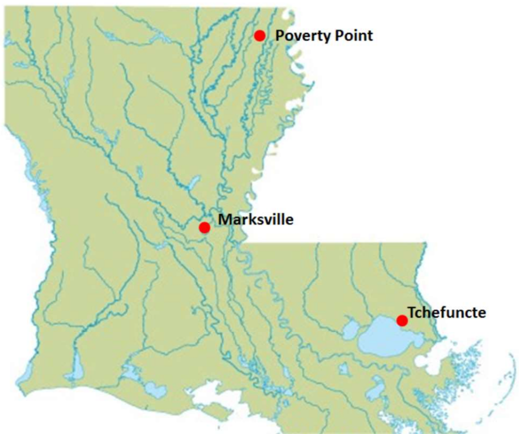
?

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.




More Text Below

Using the map in Source 1, what do all three settlements have in common?

ⓐ They were built in marshland for fishing.

ⓑ They were built on or near a water source.

ⓒ They were built in the north to avoid flooding.

ⓓ They were built on flat land for farming crops.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

**Albert Einstein**

Question 6

Line Guide

?

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.


More Text Below

Why did the people of Poverty Point **most likely** build mounds to show the North Star?

ⓐ The North Star provided light for travelers at night.

ⓑ The North Star was a spiritual symbol for the people.

ⓒ Poverty Point was directly below the North Star.

ⓓ Poverty Point was a large trading settlement.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview **Albert Einstein**

Question 7

Line Guide

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.


More Text Below

Using the second map in Source 2, which statement **best** explains why the red dots are far away from Louisiana?

(a) Early Native Americans believed those places were sacred.

(b) Early Native Americans could travel quickly and easily between the locations.

(c) Early Native Americans had a large network to trade goods from other places.

(d) Early Native Americans wanted their own land and not live close to another tribe.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview **Albert Einstein**

Question 8

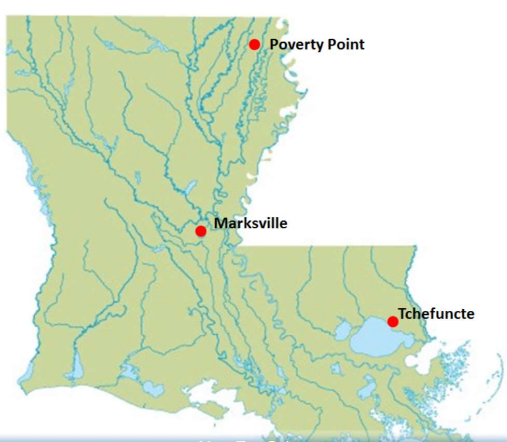
Line Guide

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.




More Text Below

Why would early Native Americans trade for goods found far away?

(a) Native Americans did not want the goods using material from the natural resources found near their homes.

(b) Natural resources were the same everywhere, but the skills to create different goods were unique only to certain tribes.

(c) Native Americans spent a lot of free time traveling across the middle of the country and exchanging goods.

(d) Natural resources vary in different locations and the Native Americans wanted goods they could not find in their land.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview **Albert Einstein**

Question 9

Line Guide

?

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.


More Text Below

Using the sources, which statement compares and contrasts the native people in Poverty Point, Marksville, and Tchefuncte?

ⓐ The Native Americans of Poverty Point and Marksville built mounds, but the Tchefuncte people did not.

ⓑ All three tribes were hunter-gathers, but the natives in Poverty Point changed farmers.

ⓒ The people of the Tchefuncte and Marksville tribe made pottery, and traded it to the people of Poverty point since they could not make pottery.

ⓓ Both Poverty Point and Marksville Native Americans left artifacts such as arrowheads, but the Tchefuncte tribe left no artifacts.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview **Albert Einstein**

Question 10

Line Guide

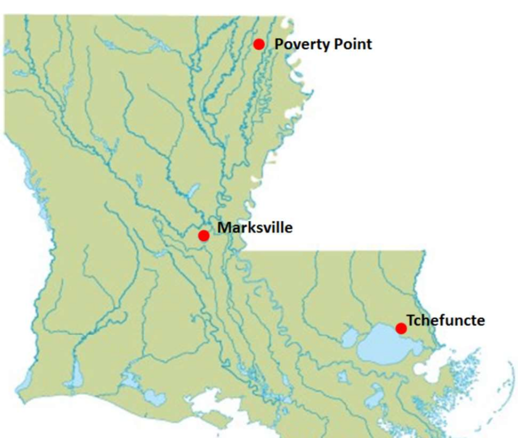
?

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.




More Text Below

Using the sources, which statement **best** explains why the earlier clay pots made by the Tchefuncte Native Americans were plain, as compared to the pottery of Marksville?

ⓐ Tools needed to decorate the pots were not discovered yet.

ⓑ At first, making pottery was out of a need and later it became an art.

ⓒ The pots were made out of red clay, which did not allow for decorations.

ⓓ The baking process to harden the pots was not hot enough to make strong pots.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview
Albert Einstein

Question 11

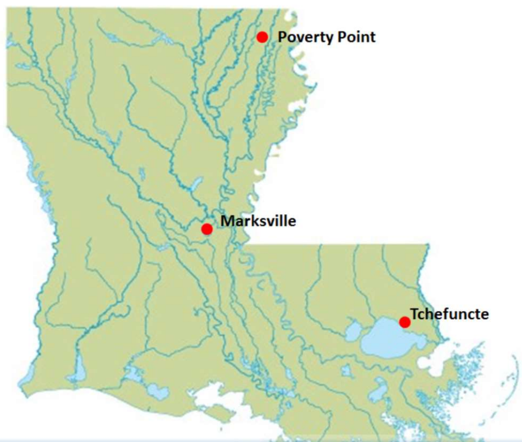
Line Guide

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.




More Text Below

What can **best** be concluded about the Tchefuncte Native Americans from the middens?

(a) They were making ceremonial mounds using trash and dirt.

(b) They had a very limited diet of deer and clams.

(c) They were able to access plenty of natural resources from both the land and water.

(d) They made a lot of waste and trash and needed a place to store it.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview
Albert Einstein

Question 12

Line Guide

**Read and study the sources about three Native American tribes in Louisiana. Then use the four sources and your knowledge of social studies to answer the questions.**

**Source 1**

**Native Americans of Louisiana**

Louisiana has a long history of many Native American tribes. This map identifies the location of three Native American settlements.


More Text Below

Which statement **best** describes why the Marksville natives may have adopted some of the Hopewell culture like mound building, but did not adopt other ideas, such as farming?

(a) The natives of Marksville had access to plenty of natural resources, so farming was not needed.

(b) The natives of Marksville lived in swamps and marshlands where farming could not be done.

(c) The natives of Marksville did not have the iron tools needed to establish farms.

(d) The natives of Marksville already had large established farms growing corn.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview Albert Einstein

Question 13

Line Guide

**Use the photos and your knowledge of social studies to answer the question.**

**Photo 1**

*Source: Jan Kronsell, Wikipedia Commons*

**Photo 2**

*Source: noaa.gov*

These photos were taken in Louisiana.

A coastal marsh is shown in

(a) both photos, because both places have water on the ground.

(b) photo 1, because trees are needed on the coast to stop soil from washing away.

(c) photo 2, because coastal marshes have grass and few or no trees.

(d) neither photo, because coastal marshes contain mostly mud and few or no plants.

Review/End Test Pause Flag Options Back Next

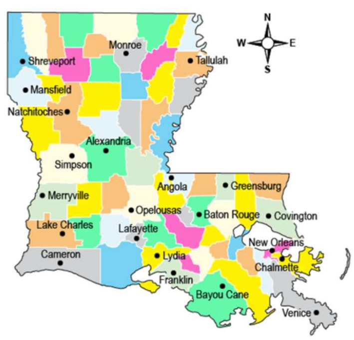
WBTE Preview Albert Einstein

Question 14

Line Guide

**Use the map and your knowledge of social studies to answer the question.**

**Louisiana**




Juan's class is studying how to use maps. The class can use this map to

(a) find cities and compare shapes of parishes.

(b) find different state resources.

(c) study how the land, rivers, and sea are used.

(d) study the rainfall of the state.

Review/End Test Pause Flag Options Back Next

WBTE Preview

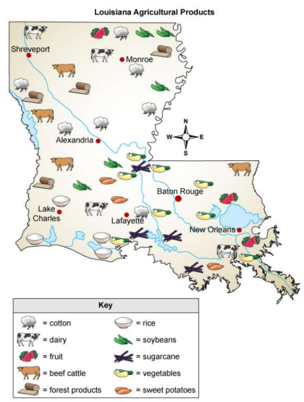
**Albert Einstein**

Question 15

Line Guide

?

**Use the map and your knowledge of social studies to answer the question.**




How do farming resources help shape the economy of southwestern Louisiana?

- (a) Farmers grow fruit and corn to sell at farmers' markets.
- (b) Farmers raise cows for milk and to sell for meat.
- (c) Farmers grow much of the rice that Louisiana sells to other states.
- (d) Farmers raise sugarcane that factories make into sugar and syrup.

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

**Albert Einstein**

**Please be sure you have answered all of the questions.**
Click on the question line to move to that question.

| Question | | Question | | Question | |
|---|---|---|---|---|---|
| 1 | (P1) | 6 | (P1) | 11 | (P1) |
| 2 | (P1) | 7 | (P1) | 12 | (P1) |
| 3 | (P1) | 8 | (P1) | 13 | |
| 4 | (P1) | 9 | (P1) | 14 | |
| 5 | (P1) | 10 | (P1) | 15 | |

**Key**

Answered | Unanswered | Flagged

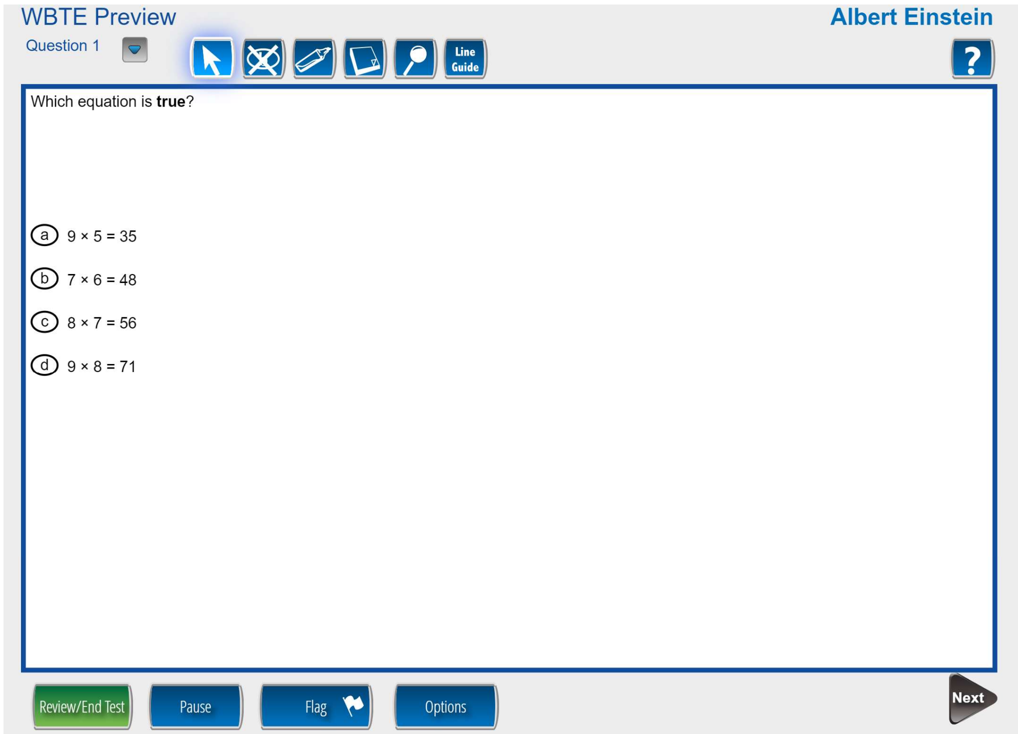
P Passage Indicator (Reading)

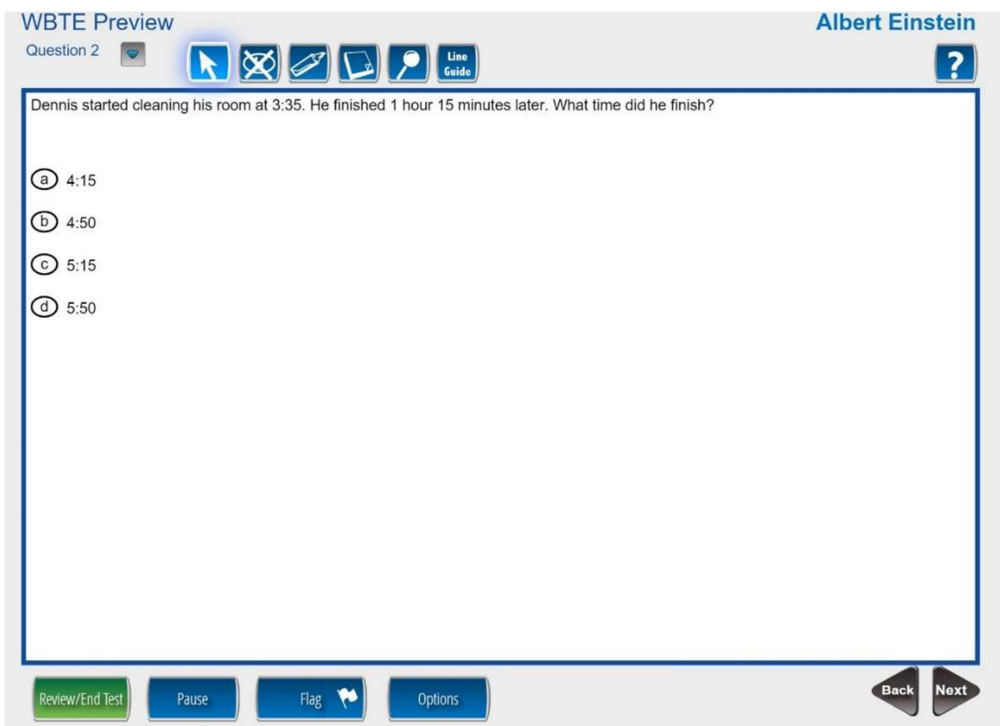
Once you have finished taking the test, click the "End Test" button to end your test.
To continue testing, click the "Return to Questions" button.

Options | Return to Questions | End Test

## Appendix G:

## EAGLE 2.0 CBT–Mathematics Grade 3 Assessment (DRC, 2017a)



WBTE Preview

Albert Einstein

Question 3

Line Guide

?

Which **two** ways show how to find the value of 30 × 5?
Select the **two** correct answers.

- ◯ 3 × 5 + 10
- ◯ 3 × 5 × 10
- ◯ 3 × 10 + 5
- ◯ 3 +10 + 5
- ◯ 5 groups of 3 tens
- ◯ 5 groups of 3 ones

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

Albert Einstein

Question 4

Line Guide

?

Solve the equation. Enter your answer in the box.

954 - 786 = ____

0/50 [ Integer Only ]

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

Albert Einstein

Question 5

Line Guide

?

Bella wants to find $48 \div 6$.

Which number sentence will help her solve this problem?

(a) $48 \times \square = 6$

(b) $6 \div \square = 48$

(c) $6 \times \square = 48$

(d) $6 \div 48 = \square$

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

Albert Einstein

Question 6

Line Guide

?

Thomas works 5 days a week at the local library for 4 hours each day. How many hours does he work in 4 weeks?

(a) 20 hours

(b) 40 hours

(c) 60 hours

(d) 80 hours

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview — Albert Einstein

Question 7

There are 6 students in the school art club. Each student painted 8 paintings. 29 paintings were sold at the school fair. The remaining paintings were hung in the school library.

How many paintings were hung in the school library?

(a) 19

(b) 21

(c) 43

(d) 48

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview — Albert Einstein

Question 8

Mr. Chang has 4 boxes of crayons. There are 12 crayons in each box. Which expression represents the total number of crayons?

(a) 4 + 12

(b) 12 – 4

(c) 4 × 12

(d) 12 ÷ 4

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

Albert Einstein

Question 9

Line Guide

?

**Use the number sentence to answer the question.**

63 ÷ ☐ = 9

What number goes in the box to make the number sentence true?

(a) 5

(b) 6

(c) 7

(d) 8

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

Albert Einstein

Question 10

Line Guide

?

Thomas has 8 boxes of candy. There are 6 pieces of candy in each box. What is the total number of pieces of candy Cade has in his boxes?
Enter your answer in the box.

☐

0/50 [ Integer Only ]

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

Albert Einstein

Question 11

Which **three** numbers round to 300 when rounding to the hundreds place?

- ◯ 312
- ◯ 250
- ◯ 395
- ◯ 346
- ◯ 249

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview

Albert Einstein

Question 12

Enter the number that makes the equation true. Enter your answer in the box.

6 × 80 = ____

0/50 [ Integer Only ]

Review/End Test | Pause | Flag | Options | Back | Next

WBTE Preview  Albert Einstein

Question 13

Line Guide

Find the missing number, *n*.

505 – 389 = *n*

ⓐ 116

ⓑ 216

ⓒ 226

ⓓ 284

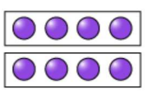
Review/End Test  Pause  Flag  Options  Back  Next

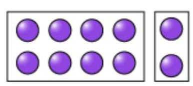
WBTE Preview  Albert Einstein

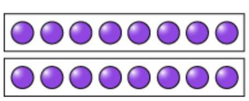
Question 14

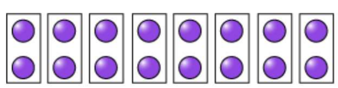
Line Guide

Stan uses counters to model math problems. Which set of counters models 8 ÷ 2 = ?

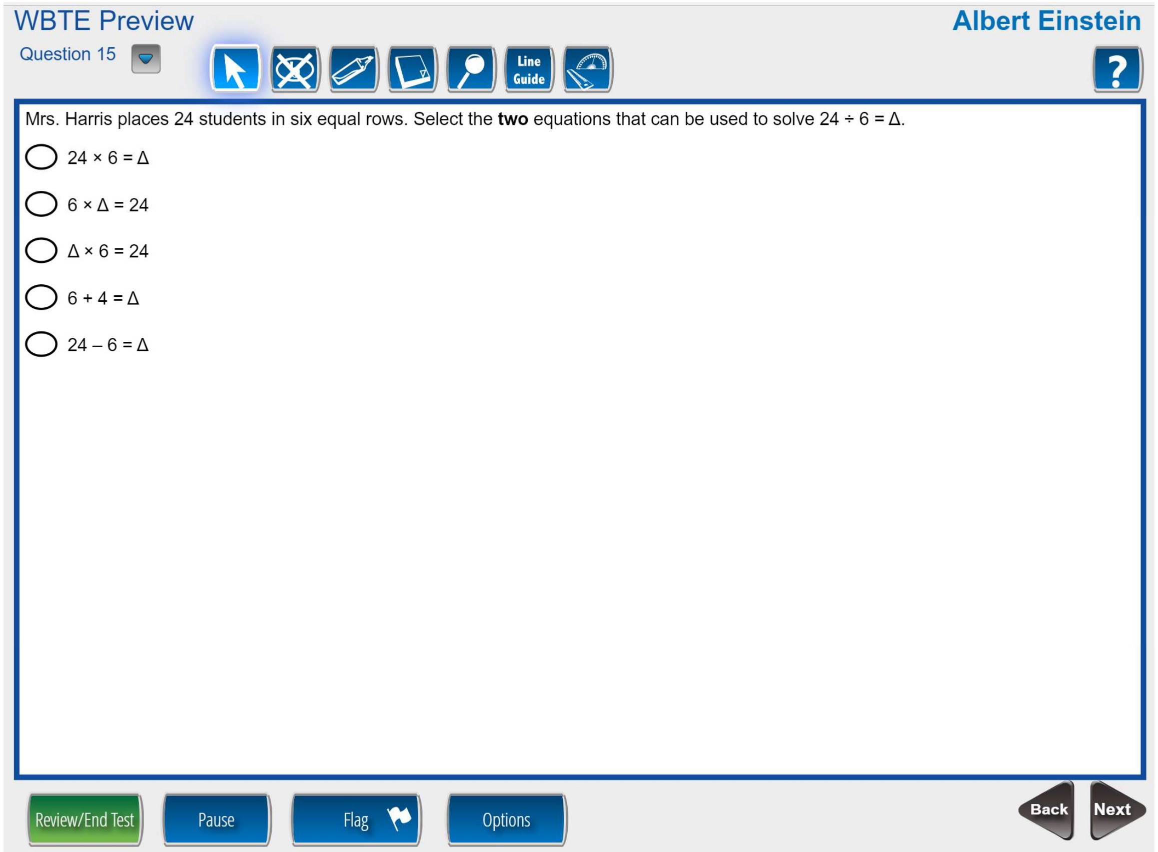
ⓐ 

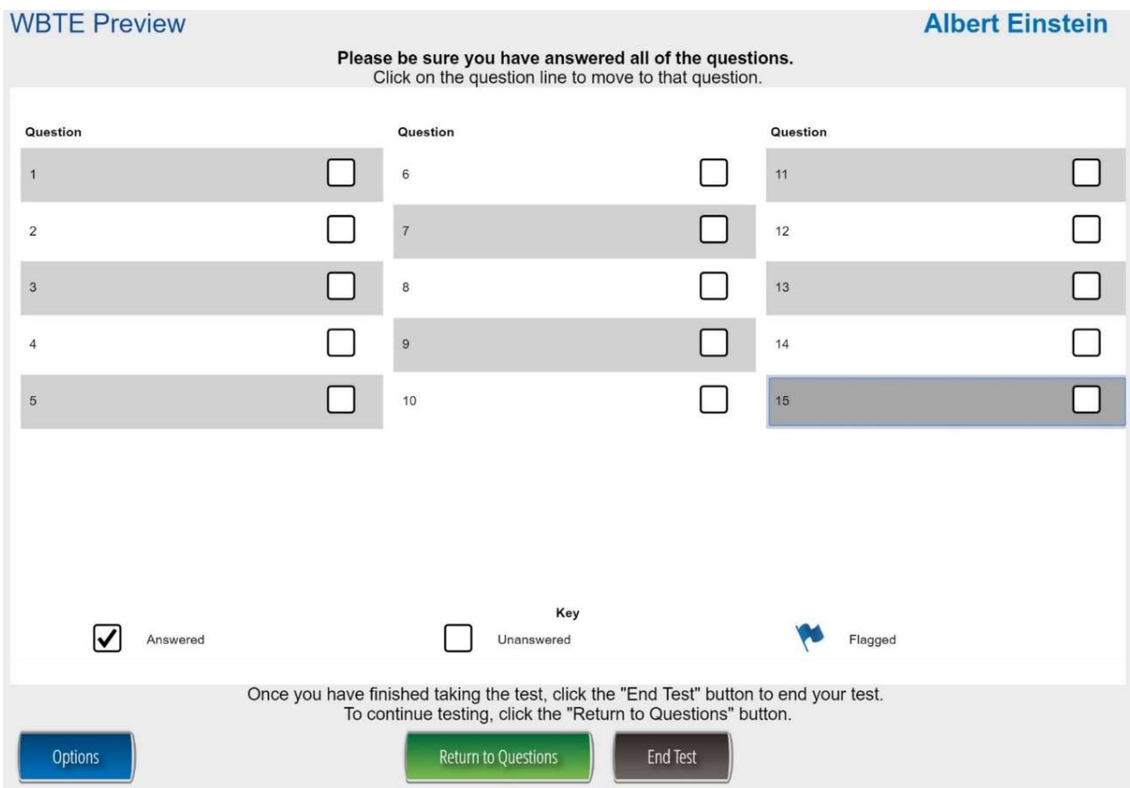
ⓑ 

ⓒ 

ⓓ 

Review/End Test  Pause  Flag  Options  Back  Next


WBTE Preview
Albert Einstein
Question 15
Line Guide
?
Mrs. Harris places 24 students in six equal rows. Select the **two** equations that can be used to solve 24 ÷ 6 = Δ.
24 × 6 = Δ
6 × Δ = 24
Δ × 6 = 24
6 + 4 = Δ
24 – 6 = Δ
Review/End Test
Pause
Flag
Options
Back
Next


WBTE Preview
Albert Einstein
Please be sure you have answered all of the questions.
Click on the question line to move to that question.
Question
1
2
3
4
5
Question
6
7
8
9
10
Question
11
12
13
14
15
Key
Answered
Unanswered
Flagged
Once you have finished taking the test, click the "End Test" button to end your test.
To continue testing, click the "Return to Questions" button.
Options
Return to Questions
End Test

**Appendix H**

**Technology-Use Baseline Survey**

Weblink: https://www.surveymonkey.com/r/YHH88RY

1. PID Number

[ ]

2. Do you use a computer at home?

- ○ Yes
- ○ No

3. Does your computer have the internet?

- ○ Yes
- ○ No
- ○ I do not know.

4. Do you use a smartphone?

- ○ Yes
- ○ No

How do you use it?

[ ]

## 5. Do you use a tablet/iPad?

- ◯ Yes
- ◯ No

How do you use it?

## 6. Do you use a video game system?

- ◯ Yes
- ◯ No

How do you use it?

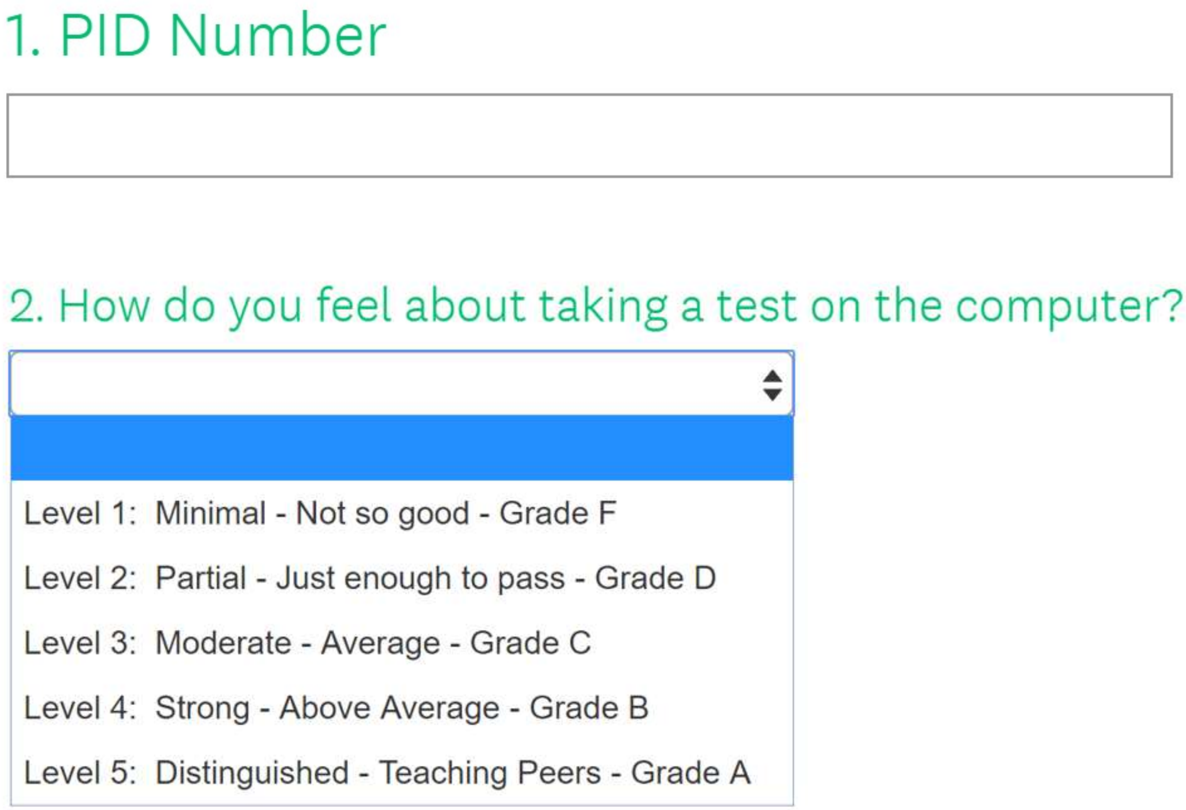
## 7. I use technology to: [choose all that apply]

- ☐ Search the internet
- ☐ Listen to music
- ☐ Send email
- ☐ Check social media
- ☐ Watch videos/movies
- ☐ Play online games
- ☐ Talk/see people
- ☐ Other (please specify)

**Appendix I**

**Computer-Based Testing (CBT)-Confidence Survey**

Weblink: https://www.surveymonkey.com/r/2SCD59Z



1. PID Number

2. How do you feel about taking a test on the computer?

Level 1: Minimal - Not so good - Grade F

Level 2: Partial - Just enough to pass - Grade D

Level 3: Moderate - Average - Grade C

Level 4: Strong - Above Average - Grade B

Level 5: Distinguished - Teaching Peers - Grade A

# Appendix J

## IRB Amendment Approval

XAVIER UNIVERSITY OF LOUISIANA
DEPARTMENT OF PSYCHOLOGY

1 Drexel Drive • Box 115
New Orleans, Louisiana 70125-1098
(504) 520-7400 • Fax: (504) 520-7952

TO: Benjamin-David Legrand, (Doctoral Student), Principal Investigator

FROM: Charles A. Gramlich, PhD
Chair of the Xavier University IRB

DATE: February 22, 2018

RE: Research Proposal entitled: "Early-childhood computer-based testing: Effects of digital literacy on affective filter and student performance." (THIS IS A CHANGE IN TITLE)

This letter addresses an amendment to the above-named study. The amendment involves adding some innocuous surveys and other minor changes that do not significantly impact participants. The changes are eligible for expedited review. The following actions have been taken.

1. The amended study is approved.
2. The additional surveys are approved.

This amended study is approved for a period of one year from the date of this memo. Any request to extend this study for more than one year must be made in writing to the Xavier University IRB at least two weeks prior to February 22, 2019. Any changes to the proposal that might affect the wellbeing of the participants must be approved by the IRB prior to implementation. Please inform the Chair of the IRB when all data collection has been completed.

This project is assigned study number #641 in the IRB files. Please refer to this project number in future correspondence regarding the study.

Reviewed and Approved

Charles A. Gramlich
Chair of the Xavier University IRB

FWA00004443
cc. Dr. Deborah Marshall, Associate VP Research and Sponsored Programs

**Parent–Guardian Informed Consent Forms: English and Spanish**

XAVIER UNIVERSITY OF LOUISIANA

IRB Approved
Research # 641

**Parent/Guardian Informed Consent Form**

October 30, 2017

I am a doctoral student under the direction of Dr. Renee V. Akbar (advisor) at Xavier University of Louisiana. I am conducting doctorate research study to examine students' understanding of computer skills and measure the effects of a digital literacy intervention on student performance.

**INFORMATION**

Your child will have the opportunity to participate in 10 digital literacy sessions during your child's social studies block with his/her teacher. One group of students will use technology to learn coding and create a video game segment. The intervention group will be randomly assigned to one of the 3rd grade homerooms. Your child will take a pretest and posttest to measure the effects of the digital intervention on student performance.

**RISK**

I do not anticipate any risk associated with the study.

**PARTICIPATION**

Your child's participation is voluntary. If you or your child choose not to participate or to withdraw from this study at any time, there will be no penalty as it will not affect your child's grade.

**BENEFITS**

Although there may be no direct benefit to your child, the possible benefit of your child's participation is development of technology skills.

**CONFIDENTIALITY**

The results of the research study may be published, but your child's name will not be used. As per State of Louisiana RS 17:3914, no identifiable information will be used. This research has been approved by the Institutional Review Board of Xavier University and the school district.

**CONTACT**

If you have any questions concerning this research study or your child's participation in the study, please call me at 504.239.8074 or email me at blegrand@xula.edu or Dr. Akbar at rvakbar@xula.edu. If you have any questions about your rights as a subject/participant in this research study, or if you feel you and your child have been placed at risk, you can contact Dr. Deborah Marshall, Associate Vice President of Research, at 504-520-5442. Additional contact information www.xula.edu/irb.

**CONSENT**

I have read this form and received a copy. I have had all my questions answered to my satisfaction. I agree to permit my child to participate in this study.

Parent Signature_____________________________________________ Date:____________

Student Signature____________________________________________ Date:____________

XAVIER UNIVERSITY OF LOUISIANA

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**Forma de Consentimiento de Padre o Guardián**

October 31, 2017

Soy un estudiante de doctorado bajo la dirección de la Dra. Renee V. Akbar (consejera) en la Universidad de Xavier de Luisiana. Yo estoy conduciendo un estudio de investigación de doctorado para examinar la comprensión de las habilidades informáticas de los alumnos y medir los efectos de una intervención de literatura digital en el logro del alumno.

**INFORMACION**

Su hijo tendrá la oportunidad de participar en 10 sesiones de literatura digital durante la clase de Estudios Sociales con su maestro. Un grupo de alumnos usara la tecnología para aprender codificación y crear un segmento de un video juego. El grupo de intervención va hacer asignado a una de las aulas de 3er grado. Su hijo(a) va tomar un examen antes para medir los efectos de la intervención digital en el logro del alumno.

**RIESGO**

No anticipo ningún riesgo asociado con el estudio.

**PARTICIPACION**

La participación de su hijo(a) es voluntaria. Si usted o su hijo(a) optan por no participar o retirarse del estudio en cualquier momento, no habrá ninguna penalidad ya que no le afectara la calificación de su hijo(a) en dicha clase.

**BENEFICIOS**

A pesar de que no habrá ningún beneficio directo para su hijo(a), el beneficio posible de la participación de su hijo(a) será de desarrollar habilidades de tecnología.

**CONFIDENCIALIDAD**

Los resultados del estudio de investigación podrá ser publicado, pero el nombre de su hijo(a) no será usado. Por el estado de Luisiana RS17:3914, ninguna información de identidad será usada. Este estudio ha sido aprobado por la Junta de Revisión Institucional de la Universidad de Xavier y por la Parroquia de Escuelas Públicas.

**CONTACTO**

Si tiene algunas preguntas acerca de estudio de investigación o acerca de la participación de su hijo(a), favor llamarme al 504-239.8074 o enviarme un correo electrónico a blegrand@xula.edu o Dra. Akbar a rvakbar@xula.edu. Si tiene algunas preguntas acerca de sus derechos como participante en este estudio de investigación, o si siente que usted o su hijo(a) ha sido expuesta algún riesgo, puede contactar al Dr. Deborah Marshall, Vicepresidente de Investigaciones, al 504-520-5442. Información adicional de contacto www.xula.edu/irb.

**CONSENTIMIENTO**

Yo he leído esta forma y he recibido una copia. Me han contestado todas mis preguntas a mi satisfacción. Estoy de acuerdo y le doy permiso a mi hijo(a) en participar en este estudio.

Firma del Padre ____________________________________________ Fecha:____________

Firma del Estudiante ________________________________________ Fecha:__________