THE EFFECTS OF EMBEDDED CONSIDERATE MULTIMEDIA FEATURES ON DIGITAL TEXT COMPREHENSION AMONG SECOND AND THIRD GRADE STUDENTS OF DIFFERENT READING ABILITIES

by

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Abstract

This research explores impacts of particular multimedia unique to digital texts on the reading comprehension of second and third grade students of low, middle, and high reading ability levels. Through a pretest posttest quasi-experimental design, each student \( n = 90 \) read a digital text on an iPad. The treatment group read one digital text with embedded video clips that support the written content, and the control group read a digital text with the same written words without video clips. The study addressed three research questions: (a) Do participants in the treatment group (VwV) and control group (VwoV) score similarly on preintervention reading characteristics? (b) Do embedded considerate video clips and reading ability impact reading comprehension as measured by a posttest? (c) Will the variable set of reading ability, prior knowledge of reading content, and reading a digital text with or without embedded considerate video clips predict to digital reading comprehension in early elementary children?

Independent t-tests determined similarities in treatment and control groups on four preintervention reading characteristics: (a) QRI-5 Total Concept Questions, (b) QRI-5 Predictions, (c) QRI-5 Total Comprehension Questions, and (d) Pretest Questions. A Factorial Analysis of Variance (ANOVA) was used to determine the differences in digital text comprehension depending on reading ability and treatment. Findings showed statistically significant differences in digital text comprehension between reading ability groups. A multiple regression analysis was used to identify relations among three independent variables: (a) control or treatment grouping; (b) reading ability; (c) prior knowledge pretest, and the possible predictability to the posttest digital comprehension test. Reading ability and prior knowledge also significantly contribute to predicting digital text comprehension.
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Chapter 1

Technology has changed how literacy is defined, used, and viewed. The convergence of literacy and technology through the introduction of computers has impacted how scholars define literacy and reading. Computers have merged with television, radio, telephones, cameras, and various other technologies (Leu & Kinzer, 2000). A text is no longer confined to a paper book or magazine, and the result of this expansion is a state of disequilibrium. Scholars and educators are attempting to integrate past research conclusions about reading traditional paper texts and print technology to inform how readers read and interact with current digital texts (Dalton & Proctor, 2008).

As scholars attempt to integrate past research conclusions about reading comprehension with the impact of digital texts on comprehension, school systems are spending large amounts of the budget on technology. The few research studies, however, are inconclusive in regards to how the technology and specifically digital elements of a text impact comprehension. The digital literacy research field is relatively new, yet the research will help inform educational institutions in regards to technology uses and purposes.

The purpose of this first chapter is to provide background information on the current state of digital reading comprehension in research and public education in the United States. The Dual Code Theory is also explained in order to frame the study and address the aims of the current research. This first chapter will conclude with the research question to be addressed in the current study.

Background

While paper texts are one type of technology, the current discussion uses the term technology as networked information and communication 21st Century technologies (ICT) such
as desktop computers, laptops, tablets, digital cameras, digital televisions, and cell phones. Print technologies are described as traditional paper texts in the current discussion.

Personal digital device sales are increasing in consumer market sales, and many educational institutions are replacing traditional paper texts with digital texts (Chen, 2010). The U.S. Department of Education provided $900 million through grants to state education agencies supporting technology in elementary and secondary classrooms in the 2009 fiscal year (State Educational Technology Directors Association, 2010). The Los Angeles Times reported that the Los Angeles Unified School District planned to spend one billion dollars to distribute iPads to 650,000 students during the 2013-2014 school year (Blume, 2013), and Forbes reported that 70 of the top 100 largest iPad purchases were to kindergarten through twelfth grade school districts (Lai, 2012). President Barack Obama also announced plans for federal aid for broadband expansion (Morelli, 2015). Funding for technology is increasing and more students are interacting with computers than ever before in the classroom. However, there is still a discrepancy between time spent reading digital texts in school and out of school (Chen, 2010; Cheung & Slavin, 2011).

Funding for technology in education may be increasing, but current research on the impact of digital technologies on reading comprehension is inconclusive and scarce. A review of four leading literacy journals found that less than five percent of literacy articles focused on technology (Tracey & Young, 2007). Additionally, little research currently exists using a digital touch screen tablet for reading (Murray & Olcese, 2011; Northrop & Killeen, 2013; Seyit, 2010; Sheppard, 2011; Simpson, Walsh, & Rowsell, 2013).

Variability in the discussion of digital reading comprehension is common as identified in several meta-analyses (Blok, Oosterdam, Otter, & Overmaat, 2002; Dynarski, Agodini,
Heaviside, Novak, Carey, Means, et al., 2007). One of the findings of Blok et al.’s meta-analysis was the large variance in duration of the treatment and exposure to treatment. The duration of the studies analyzed ranged from one week to 75 weeks with an average of 12 weeks. The exposure to treatment ranged from one hour to 40 hours with an average of seven hours. Looking at the averages, seven hours of treatment over 12 weeks is considered low intensity (Blok et al., 2002). Rigorous and higher intensity studies are necessary in the field of technology and reading (Blok et al., 2002; Labbo & Reinking, 1999; Tracey & Young, 2007).

Educators and educational stakeholders may refer to existing research in order to influence technology purchases and make instructional decisions for students. Several studies have found increased vocabulary acquisition, fluency, and comprehension in participants when reading digital texts (Doty, Popplewell, & Byers, 2010; Grimshaw, Dungworth, & McKnight, 2007; Korat, 2010; Korat & Shamir, 2008; Labbo & Kuhn, 2000; Segal-Drori, Korat, Shamir, & Klein, 2010). Other studies, in contrast, have shown negative or no impact on vocabulary acquisition, fluency, and comprehension measures of participants when reading digital texts (Blok et al., 2002; De Jong & Bus, 2002; Kulik, 2003; Shin, Schallert, & Savenye, 1994). The discrepancy of findings may be a result of too few participants, a range of ability of the readers, and a mixture of multimedia that supports or distracts from the written text. Keeping these findings in mind, the current study addressed some of the methodological shortcomings of previous research by recruiting over 150 participants, grouping readers by ability, and only presenting multimedia that supports the written text. Participants also read digital texts on an iPad touch screen tablet in the current study.

**Theory**
Reading is a very complex experience, and the elements of reading have been debated, defined, and redefined for nearly 40 years through a variety of scientific and literary theories (Kintsch, 1988; Rosenblatt, 1978; Rumelhart & Ortony, 1977; Sadoski & Paivio, 2007). The few research studies that have pertained to reading comprehension of digital texts have relied heavily on research related to reading comprehension of traditional paper texts. The current study draws on such theories, and particularly focuses on the Dual Code Theory.

The study of reading comprehension has beginning roots in cognitive psychology and has evolved throughout the past 75 years (Pearson, 2009). When modern cognitive psychology began to take shape in the 1950s and 1960s, and eventually reading process theories in the 1960s and 1970s, theorists believed that the best way to understand cognition was to first understand the subset pieces of cognition. Over time, however, this piecemeal strategy only opened the possibility for many small theories to develop, and theorists collaborated very little for many years (Sadoski & Paivio, 2007).

The Dual Code Theory, however, is a broad theory of reading that attempts to unify many smaller reading theories. The authors argue that previous theories are incomplete and by borrowing some of the ideas, the Dual Code Theory will be a more comprehensive theory. The theory allows for fluidity and evolution of reading digital texts since “all scientific theories are tentative, imaginatively exploring and advancing toward better, more precise, and more inclusive theories in an ongoing, asymptotic approach to understanding” (Sadoski & Paivio, 2007, p. 338).

In the Dual Code Theory, Sadoski and Paivio (2007) describe a continuum between the text and the reader and situate comprehension in the center (See Figure 1).

![Figure 1. Continuum in Dual Code Theory](image)

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![Figure 1. Continuum in Dual Code Theory](image)
As shown in Figure 1, comprehension is in the center of the continuum because both textual elements and reader elements contribute to reading comprehension. The textual and reader elements are categorized in the literature review for the current study, and related research was drawn upon when the researcher authored digital texts and methodologically designing the study.

Sadoski and Paivio (2007) also identify two sensory experiences, or modes, in the Dual Code Theory: verbal and nonverbal. The verbal experiences are related to the verbatim language in the text. The phonemes, word pronunciations, intonation, spellings, and punctuation all contribute to the verbal mode. The nonverbal experiences relate to the mental imagery that is activated by reading the texts. The smells, sights, sounds, tastes, touches, and emotions evoked by the text all contribute to the nonverbal mode. The engagement and motivation of a reader to interact with the text is also part of the nonverbal experience. These sensory modes are also used to organize existing research in the literature review.

In addition to the body of research related to reading comprehension, the author also explored the body of research related to haptic touch. Participants in the current study read digital texts on an iPad, and the touch screen aspect of a tablet creates a different reading experience compared to a three dimensional keyboard. Some researchers believe touch is a third unique mode that interacts with verbal and nonverbal modes during the reading of digital texts on a touch screen (Mangen, 2008; Sheppard, 2011; Simpson et al., 2013). These relationships and related research are explored through the literature review and the current study.

Fox and Alexander (2009) argue that perhaps growing research related to digital texts support a need for a “fundamental reconceptualization of the nature of text comprehension” (p.232). Past models and theories of reading comprehension hypothesize that readers use prior
knowledge to construct their own meaning of a text; however, some recent researchers believe that reading is becoming more of a connective activity rather than a constructive activity (Fox & Alexander, 2009; Kamil & Chou, 2009). The ability, therefore, to connect and synthesize information from a variety of textual elements such as written language, animation, or verbal language while reading is a skill set that may be unique for digital readers compared to readers of traditional paper texts (Coiro, 2007; Leu, O’Byrne, Zawilinski, McVerry, & Everett-Cacopardo, 2009).

In a digital text, the written text and device can be separated because the text can change without the electronic device changing. For example, the same iPad device can have many different texts downloaded. A reader can easily change the text without changing the physical iPad. This is not possible with a traditional printed text; a tangible printed text cannot separate the written text from the paper because the content is physically on the paper. A reader has to physically change books in order to read a different text. This separation between text and device is an issue around materiality, and it may impact how a reader perceives a digital text. Diverse functionalities may also impact how a reader perceives a text. A digital device, such as an iPad, can be used for multiple purposes; a user may read a text, then play a game, or take a picture. A printed text, however, has a single function. Materiality and functionality related to digital devices and texts should continue to be explored (Dhir, Gahwaji, & Nyman, 2013; Mangen, 2008; Morineau, Blanche, Tobin, & Gueguen, 2005).

**Outline of Study**

The purpose of the current research study is to explore possible impacts of particular multimedia unique to digital texts on the reading comprehension of young elementary school students. Through a pretest posttest quasi-experimental design, each student read a digital text
on an iPad. The subsequent literature review in Chapter 2 shows four gaps that are addressed in the current study: (a) in previous research, researchers have not always clearly categorized digital multimedia features nor presented multimedia in isolation to subjects; this current study only used clearly categorized embedded video clips that support printed text content; (b) participants in similar digital-text-based reading comprehension studies have often been secondary school aged students; whereas, in this current study, the targeted students were second and third grade students; (c) in other research, narrative structures of digital storybooks have been explored with young students, but not many studies have used expository text structure of a digital book, which will be the focus of the present investigation; and (e) digital texts on a touch screen tablet have not been thoroughly explored with groups of young students to study their comprehension of expository texts; this study utilized iPads to do so.

This research explored the impact of specific embedded multimedia in a digital text on reading comprehension at low, middle, and high reading ability levels. The researcher consulted existing research on considerate informational texts to author a digital text using the iBooks application on an iPad. Armbruster and Anderson (1981) identified various text features and structures that authors use to facilitate reading comprehension of content area textbooks. Relevant text features and organized structures that support the reader and minimize cognitive effort to comprehend the author’s message were categorized as considerate features. In contrast, inconsiderate features distract the reader from the content and demand more effort from the reader. The digital texts used in the current study did not include inconsiderate features.

Chapter 3 outlines the methodology and variables of the pretest posttest quasi-experimental design study. The researcher authored an informational text on a second grade reading level using various readability formulas and leveling criteria. The participant reading
levels were identified using time-tested measures; participants individually read aloud a second grade appropriate passage to the researcher. The researcher recorded decoding and comprehension ability. Participants also individually answered pretest concept questions related to the researcher created digital text, *Vegetables*. Participants read one of two versions of the digital text, *Vegetables*, on an iPad. The treatment group read the text with specific multimedia embedded that supports the written content, and the control group read the digital text with the same written words without multimedia. A multiple regression was used to identify relations among the three independent variables: (a) control or treatment grouping, (b) reading ability, (c) prior knowledge pretest, and the possible predictability to the posttest digital comprehension test.

**Aims of Research**

The goal of the current research is to explore possible impacts of particular multimedia unique to digital texts on reading comprehension of various leveled elementary school readers with iPads. As noted above, the study attempted to address four gaps in previous research related to digital texts on touch screens and reading comprehension. Findings of the current study may also assist administrators and educators to make informed decisions regarding touch screen technologies for use with readers of various levels.

**Research Questions**

1.0 Do participants in the treatment group (VwV) and control group (VwoV) score similarly on preintervention reading characteristics?

2.0 Do embedded considerate video clips and Reading Ability impact reading comprehension as measured by a posttest?
3.0 Will the variable set of reading ability, prior knowledge of reading content, and reading a digital text with or without embedded considerate video clips predict to digital reading comprehension in early elementary children?
Chapter 2

Previous research related to reading comprehension when reading traditional print texts contributes to the new exploration of reading comprehension when reading digital texts. This research will be explored as well as theoretical elements that contribute to reading comprehension. The literature consulted for the current study is organized by two types of elements contributing to reading comprehension: (a) textual elements, and (b) reader elements. These elements are further divided into two modes that interact during a reading experience: (a) verbal, (b) nonverbal. Currently, there is a discussion about a third, possibly additional mode, touch, which may influence the reading experience. The literature review is therefore organized based on the cognitive theory elements and modes into five sections: (a) textual verbal, (b) textual nonverbal, (c) reader verbal, (d) reader nonverbal, and (e) touch related to reading comprehension.

The current study analyzed the effects of various factors on a student’s ability to correctly answer eight recall multiple-choice questions directly related to a nonfiction digital text read on an iPad. Recall questions are a means to measure reading comprehension. The large body of research around reading comprehension was first consulted for this literature review. The researcher of the current study consulted the research surrounding textual elements in order to author the digital texts used in the study and isolate the central textual difference, which is the embedded considerate multimedia, as detailed below.

Studying reading comprehension presents challenges because it is only indirectly observable through various residual effects (Pearson & Johnson, 1978). A teacher or researcher relies on asking questions, requesting critiques, or asking for interpretations instead of directly observing how an individual reader interacts or understands a text (Pearson, 2009). It is possible to explore
some contributing elements of reading comprehension, even though observing comprehension is impossible.

Research has demonstrated that both textual elements and reader elements contribute to reading comprehension (Duke & Carlisle, 2011; Pearson, 2009; Pressley, 2001; Rosenblatt, 1978; Sadoski & Paivio, 2007). While textual elements typically include vocabulary difficulty (Anderson & Freebody, 1981; Anglin, 1993; Graves, 2006; Stahl & Fairbanks, 1986; Wasik & Bond, 2001), word choice (Adams, 1990; Armbruster & Anderson, 1981; Baker & Beall, 2009), and text structure (Alvermann, 1982; Alvermann & Boothby, 1982; Armbruster & Anderson, 1981; Meyer, 1975), some reader elements include an individual’s ability to decode (Baker & Beall, 2009; Zinar, 2000), a reader’s prior knowledge (Miller & Faircloth, 2009), and the reader’s motivation (Baker & Wigfield, 1999). This body of research has influenced recent studies investigating the impact of unique textual and reader elements in digital texts on reading comprehension (Doty et al., 2010; Korat, 2010; Sheppard, 2011).

The Dual Code Theory identifies two sensory experiences that contribute to reading comprehension (Sadoski & Paivio, 2007). This is based in the belief that humans process information through two modes, or channels—a verbal channel and a visual channel (Baddeley, 1999; Mayer, 2008; Paivio, 1986). Sequence and time govern language and sound, while space and display govern images and visuals (Warschauer & Ware, 2008). Vocabulary difficulty, word choice, and text structure are described below as textual elements that impact a verbal mode and are categorized as textual verbal elements. Illustrations and animations are textual elements that impact a nonverbal mode and are described as textual nonverbal elements.

A review of the literature describing reader elements contributing to comprehension follows the textual elements. Decoding and listening are reader elements that impact a verbal
mode and are categorized as *reader verbal elements*. Prior knowledge, motivation, engagement, and interaction with the text are reader elements that impact a nonverbal mode and are categorized as *reader nonverbal elements*.

A review of the literature impacting a possible third mode, touch, is described following the textual elements and reader elements. Touch can be considered a *reader nonverbal element*, but some research suggests it can be a third distinct mode interplaying with verbal and nonverbal modes (Walsh & Simpson, 2013). A review of the recent body of research regarding haptics and the new research studies around digital touch screens are described at the end of this literature review in order to situate the current study among the existing body of research.

**Textual Elements: Verbal and Nonverbal**

**Textual verbal elements.** Vocabulary difficulty, word choice and text structure are considered to be textual verbal elements that impact reading comprehension in different ways. Word choice is a textual element directly related to vocabulary knowledge. In contrast, vocabulary knowledge is an element brought to the reading experience by a reader, while the vocabulary difficulty in a given text is a textual element. The following section reviews research related to vocabulary difficulty, word choice, and text structure.

Separating vocabulary and reading comprehension is difficult, if not impossible (National Reading Panel, 2000). Vocabulary and comprehension together reflect a person’s overall knowledge, and vocabulary knowledge may actually be indicative of a person’s overall topic knowledge (Anderson & Freebody, 1981). Seigneuric and Ehrlich (2005) conducted a three-year longitudinal study across grades two, three, and four with 56 seven-year-olds. Each child was tested on phonological ability, vocabulary, working memory, and comprehension in first, second,
and third grade. Vocabulary emerged as a direct predictor of comprehension across all three grades.

Nagy (2007) argues that the correlation between vocabulary and reading comprehension is actually the result of a third construct, metalinguistic awareness. The ability to understand and manipulate syntax, semantics, and morphemes are all part of metalinguistic awareness. Anglin (1993) studied the vocabulary knowledge of first, third, and fifth grade students and specifically the impact of morphemes and different forms of a word on vocabulary knowledge. Researchers have estimated that third graders have about 10,000 to 20,000 words in their vocabulary, but many of the words are only known because students understand the morphemes of the word or the structure of the word (Anglin, 1993; Graves, 2006; Nagy & Anderson, 1984).

Many studies have concluded that young children from lower socio-economic status (SES) households have lower vocabulary knowledge compared to their peers living in higher economic status households (e.g. Anglin, 1993; Biemiller & Slonim, 2001; Graves, 2006; Hart & Risley, 1995). Some of this lower vocabulary knowledge is a result of only hearing and using casual discourse, which is characterized by only 400 to 800 words. Formal or consultative discourse, used in school or employment settings, must be directly taught and practiced. “The majority of minority students and poor students do not have access to formal register at home” (Payne, 2003, p. 42). The students in the current study attend a school that reported greater than 95% of students received free and reduced meals in 2014 (www.mdreportcard.org, 2013).

The previously described research has influenced vocabulary research with digital texts. Higgins and Cocks (1999) conducted a pretest-posttest study with 15 third grade students. Students in the study interacted with an electronic book on a Compact-Disc Read-Only-Memory (CD-ROM) by listening to passages with six selected unknown vocabulary words. After a
passage was read, students watched short animations of the vocabulary word and were asked to explain to the researcher the meaning of the word. Students were later asked to define the target words after a lapse of four days of listening to the text and watching the animations. All students except one increased the vocabulary score on the posttest compared to the pretest supporting the benefit of a digital text format with embedded animations; however, with the lack of a control group, it is unknown if these results are unique to this condition.

Vocabulary difficulty and grade level appropriate topics are important textual elements, but these elements cannot be considered in isolation; they are impacted by the genre of a text. The few published studies that have included elementary age participants reading a digital text have most often used storybooks (Doty et al., 2010; Grimshaw et al., 2007; Korat, 2010; Korat & Shamir, 2008; Labbo & Kuhn, 2000; Larson, 2010; Segal-Drori et al., 2010). Storybooks are considered easier for young children to read because they use familiar textual and vocabulary elements. A storybook structure is predictable due, in part to young students’ experiences with narratives at home and in school settings (Brennan, Bridge, & Winograd, 1986; Mulcahy & Samuels, 1987). In contrast, expository texts use different vocabulary, syntax, positioning of main idea, and often contain more complex concepts than storybooks (Alexander & Judy, 1988; Armbruster & Anderson, 1981; Duke & Bennett-Armistead, 2003). Recent national curriculum, however, has focused on the importance of using informational expository texts in the classroom from the onset of schooling for young children in order to expose them to texts used most often in a college and career setting.

There are many types of information and expository texts for children. Armbruster and Anderson (1981) identified four maxims to produce what are termed considerate informational texts. A considerate text is designed by the author to enable readers to learn content with
minimal cognitive effort. The four maxims of considerate texts are: (a) audience appropriateness, (b) structure, (c) coherence, and (d) unity (Armbruster & Anderson). The first maxim, audience appropriateness, relates to topic appropriateness and vocabulary difficulty or word choice considerations as previously described.

The second maxim, text structure, is identified because of the impact on reading comprehension. Authors use text structure to depict relations among the content of the text. The organization of ideas helps the author effectively communicate content to the reader (Meyer, 1975). Readers are more likely to recall content from clearly organized texts compared to loosely organized or confusing texts (Alvermann & Boothby, 1982). Additionally, the structure of the text should match the author’s purpose (Armbruster & Anderson, 1981). For example, the structure of an argumentative text oscillates between the argument and the counter-argument, but the structure of an informational text presents the main idea of a subject and the supporting details.

Armbruster and Anderson’s (1981) third maxim is coherence. Content in an informational considerate text should be presented in an organizational structure, and the ideas should logically connect. This integration and logic promotes textual coherence. Coherence at the overall text level and the sentence level are important to support comprehension and recall. Visuals and non-fiction text features such as titles and diagrams are examples of text level coherence. Repetition of concepts and explicitly naming connections are examples of sentence level coherence.

The fourth maxim of a considerate text is unification. A considerate text should be unified around a single purpose and not include distracting or irrelevant information. Readers integrate new information with previously learned information as they read. This new
information is more likely to be remembered if it is directly relevant to the previous information (Armbruster & Anderson, 1981). While the maxims of considerate informational texts were created in an era of traditional paper texts, the maxims should be applied to digital texts to support readers in comprehension.

Some considerate verbal features are unique to digital texts. Pop-up dictionaries and narration of the text are examples of considerate features that several studies with young children have identified as positively impacting reading comprehension. Doty et al. (2001) compared retelling ability and responses to oral comprehension questions after 39 second-grade students from a Title I elementary school read either a traditional paper text or a CD-ROM text independently. The CD-ROM text isolated the considerate digital verbal element of being able to click on a word for the pronunciation and definition. The students who read the CD-ROM text had significantly higher reading comprehension as indicated by the oral comprehension questions.

Pop-up dictionaries and textual supports embedded in digital texts provide readers the privacy and confidentiality of questioning an unknown word; the request for help is unknown to surrounding peers (Greenlee-Moore & Smith, 1996). Results are inconclusive, however, as to whether the pop-up dictionary feature provides significant additional comprehension support. Some studies found no significant difference in comprehension with the use of a pop-up dictionary feature with young elementary students even though participants consulted the digital dictionary significantly more often than a print dictionary (Grimshaw et al., 2006; Korat & Shamir, 2008).

Listening comprehension has been found to be higher than reading comprehension in elementary age children (Durrell, 1969). The recent digital narration studies described compared
listening comprehension of a digital text to reading comprehension of a traditional print text. Recent studies have included digital narration as a considerate multimedia feature embedded in digital texts. Listening to a digital text has been compared to independently reading a printed text, with findings concluding that comprehension and retelling of the texts were better with the digital text experience (Greenlee-Moore & Smith, 1994; Grimshaw et al., 2006; Korat 2010; Korat & Shamir, 2008; Matthew, 1997; Segal-Drori et al., 2010). In one study, participants ages nine, ten, and eleven-years-old had significantly higher comprehension scores when a storybook CD-ROM text was narrated. The narration was attributed to reducing the load on participants’ working memories while the narrator’s intonation and prosody provided a richer context to the storyline (Grimshaw et al., 2006). In a different study, Korat and Shamir did not isolate the digital narration from embedded dictionaries or animations, so it was unclear whether the digital narration or a different multimedia feature positively impacted reading comprehension scores for participants.

**Textual nonverbal elements.** In addition to the textual elements related to the verbal mode or sensory experience of a reader, textual elements can also appeal to the nonverbal mode. The textual nonverbal elements include images and visuals. Some traditional print texts provide static illustrations and photographs to support the nonverbal mode of the reading experience. In contrast, some digital text images embed movement or sounds.

Illustrations can support textual comprehension by building useful mental models and focusing the reader’s attention on relevant information (Mayer, 1989, 2008). Multimedia features in a digital text have expanded and transformed these static images into dynamic images. Mayer refers to dynamic images as images that combine visual and verbal communications and include multimedia such as animations or videos. Digital animation and
sounds from multimedia provides some of the nonverbal experience for the reader; the reading experience does not all occur in the reader’s imagination.

Korat and Shamir (2008) and Labbo and Kuhn (2000) expanded upon Armbruster and Anderson’s (1981) maxims of considerate text structures when evaluating digital texts. While reviewing several digital texts, researchers encountered some digital animation that supported the written storyline of a text and therefore labeled it as considerate; some of the animation aided readers’ understanding of the storyline. In contrast, other animation distracted the reader from the written storyline and was labeled inconsiderate. For example, when an animated character sighed and put his head down, the researchers identified it as considerate because it supported the written story that the character was tired. A frying pan that turned into a butterfly was inconsiderate because it did not relate to the storyline and could distract readers. To be considerate, animation sequences should be both relevant and reflective of the written story.

Mayer (2001) developed seven design principles for authors to considerately use multimedia in order to support reader comprehension of a digital text: (a) Multimedia Principle: combine visual and verbal presentations rather than present information using one mode; (b) Spatial Continuity Principle: present visual and verbal information in close proximity on a page or within a presentation; (c) Temporal Contiguity Principle: present visual and corresponding verbal information simultaneously, rather than sequentially; (d) Coherence Principle: restrict presentation to relevant information; (e) Modality Principle: oral narration, rather than written narration, should be presented with animations; (f) Redundancy Principle: do not provide oral and written narration with animations; (g) Individual Differences Principle: reader elements influence comprehension.
Mayer’s seven design principles have been shown to be relevant to the design of digital texts and readers’ comprehension (Dalton & Proctor, 2008); however, Mayer’s research has been conducted primarily with university students and may not hold true for young readers (Palincsar & Dalton, 2005). Additionally, many studies in the current body of research did not categorize digital features as considerate or inconsiderate. Some studies have concluded that multimedia positively supports comprehension (Chan & Unsworth, 2011; Kim, Yoon, Whang, Tversky, & Morrison, 2007; Verhallen, Bus, & de Jong, 2006) while other studies have reported multimedia distracts from comprehension (Korat & Shamir, 2008; Mayer, Hegarty, Mayer, & Campbell, 2005). The lack of differentiation between considerate and inconsiderate multimedia could be a contributing factor to the inconsistent findings of the studies in this body of research and presents a limitation of the research addressed by the current study.

Chan and Unsworth (2011) studied 25 sixth-graders to determine how digital images support or hinder online textual information. Digital graphic information was interpreted as reinforcing new learning when it complemented the text; also readers were more likely to remember the information. However, if the information in the digital text required readers to synthesize information with the interactive image, it was much more difficult for readers to comprehend.

The impact of digital images has also been studied in young children. Kindergarten children identified as at-risk read two texts on the computer; in one condition the text presented had static pictures while the other condition had animation. Measures of retelling and comprehension of implied actions in the story were significantly higher for participants that read the text with animation (Verhallen et al., 2006).
Young participants sometimes can interact with a CD-ROM text by clicking on specific places embedded in the text. These specific places, commonly referred to as hotspots, result in a change or reaction within the text; for example, the words or object clicked will become animated. A digital text with many hotspots have been labeled in several studies as the “play version” of the text, and studies have concluded that often these hotspots are not beneficial to comprehension; however, the hotspots are not identified or categorized by considerate or inconsiderate (Korat & Shamir, 2008). It is unclear how considerate hotspots compare to inconsiderate hotspots in relation to comprehension.

Fourth-graders have demonstrated preference to animation and embedded hotspots compared to static graphics. Kim et al. (2007) studied comprehension, perceived comprehension, and preference of texts with animations and static illustrations with 101 fourth graders. The researchers determined students’ Need for Cognition (NFC) level, an individual’s tendency to engage in and enjoy effortful cognitive endeavors, prior to reading. Students with low tendencies to engage in and enjoy effortful cognitive endeavors reported higher perceived comprehensibility of a text with animation.

Other studies have reported that multimedia distracted participants. Mayer et al. (2005) studied 197 university students that were asked to retain and transfer procedural information learned in two learning environments. Participants learned about one of four scientific procedures: (a) how lightning develops, (b) how a toilet tank works, (c) how ocean waves form, and (d) how a car’s brake pedal works. Each procedure was taught through two text conditions: (a) a computer-based animation with narration, or (b) a written text with static pictures. Results indicated that for each scientific procedural explanation, participants in the written text with static pictures condition retained and transferred more than the participants watching the
animation with narration on the posttest. This conclusion supports the static media hypothesis that dynamic media creates extraneous and unnecessary processing for the reader. The static media hypothesis suggests that the entertaining features of dynamic media distract learners resulting in less comprehension regardless of the author’s intent to be considerate (Mayer, 2001).

However, as the Dual Code Theory (Sadoski & Paivio, 1997) explains, the written text and the embedded multimedia only partially contribute to the reading experience. Each reader brings unique reader elements to the reading experience; research related to these reader elements will now be presented.

**Reader Elements: Verbal and Nonverbal**

Reading comprehension is influenced by reader elements as well as the previously described textual elements. Sadoski and Paivio (2007) identified two sensory experiences, or modes in the Dual Code Theory: verbal and nonverbal. The verbal experiences are related to the verbatim language in the text. The decodability, word pronunciation, word recognition, intonation, fluency, and prosody all contribute to the verbal experience. In contrast, the nonverbal experiences are related to the mental imagery that is activated by reading the text as well as reader engagement and motivation.

**Reader verbal elements.** Several studies have determined that a reader’s ability to easily decode and recognize words within the text provide a strong predictability of reading comprehension (Baker & Beall, 2009; Gough, 1984; LaBerge & Samuels, 1974; Rosenblatt, 1978; Stanovich, Nathan, & Vala-Rossi, 1986; Zinar, 2000). Readers that easily translate the written alphabetic symbols to oral language are more likely to comprehend when reading. Rapid word recognition allows the reader to use mental resources to think about the content and meaning of the text rather than symbol translation (Roberts, Christo, & Shefelbine, 2011).
Zinar (2000) tested 96 fourth grade students on word identification, reading comprehension, and comprehension monitoring skills. The word identification subtest was the strongest predictor of reading comprehension \( (r = .68, p < .001) \). Similarly, Nation (2005) conducted a comprehensive review of the psychological research on elementary school children with reading comprehension difficulties. She concluded that decoding skills are necessary but not sufficient for reading comprehension to occur. The automaticity of word recognition and accuracy of decoding the words are two of the three components of the reading fluency. The third component is prosody, how the reader uses rhythm, stress, and intonation when reading aloud (Rasinski, Reutzel, Chard, & Linan-Thompson, 2011).

One limitation in studies of reader verbal elements was procedures for measuring comprehension. Some researchers allowed participants to refer back to the text when answering comprehension questions (Grimshaw et al., 2007), while other researchers prohibit participants from referring back to the text (Wright, Fugett, & Caputa, 2013). It cannot be stated with certainty that participants did not simply turn pages of the text during reading time and then at testing go search for answers to the comprehension questions in the text.

**Reader nonverbal elements.** A reader contributes more than just the verbal elements to a reading experience. The smells, sights, sounds, tastes, touches, emotions, engagement, and motivation evoked by the text all contribute to the nonverbal mode. Nonverbal experiences relate to the mental imagery, which can be multimodal, and sometimes can even approach actual experience (Sadoski & Paivio, 2007).

Prior knowledge may effect engagement because existing content knowledge helps the reader to build connections and construct stronger bonds (Vygotsky, 1978). A reader has better overall topic knowledge and will be more familiar with topic-related vocabulary when the text content is
related to his/her personal experiences within the social-cultural dimensions. Experiences and interactions with peers, family, and community impact how a reader approaches a text. This knowledge translates into a stronger effect on comprehension (Miller & Faircloth, 2009).

Coiro and Dobler (2007) qualitatively explored prior knowledge in a digital setting. The researchers conducted interviews with 11 sixth-grade students and identified four different types of prior knowledge related to online reading experiences: (a) prior knowledge of topic, (b) prior knowledge of printed information text sources, (c) prior knowledge of informational website structures, and (d) prior knowledge of web-based search engines. Prior topic knowledge may be the most beneficial type of prior knowledge when reading a traditional paper text. However, prior topic knowledge may not be as important when reading digital texts because a successful online reader can rely on complementary digital features to find related information and supplement a lack of prior topic knowledge (Coiro, 2007).

Shin et al. (1994) conducted a mixed methods study with 110 second grade students exploring the effects of prior topic knowledge on digital CD-ROM texts with hypertexts structures. The researchers analyzed how students with low prior topic knowledge or high prior topic knowledge performed within two different digital text structures: (a) a hierarchial hypertext structure that was linear and restrictive, and (b) a network hypertext structure that was a web of hyperlinks and not restrictive. Results indicated that students with low prior topic knowledge were more effective in highly structured hierarchial hypertext systems and became frustrated and lost in the network hypertext structure. These results were similar to findings that readers with low topic knowledge became easily disoriented when reading on the Internet (Chan & Unsworth, 2011; Coiro, 2011; Coiro & Dobler, 2007).
Even in the linear digital text structure, however, the reader must adjust to the hyperlinks, icons, interactive photographs, diagrams, and multimedia clips such as video or audio clips in addition to being flexible with traditional reading strategies (Chen, 2010; Spiro, 2004). The interactive component of digital texts presents the reader with choices; the reader makes the choice when to read the written text and when to watch a related video clip. Readers can choose whether to read or view part of the text or the entire text before interacting with a digital component. Skilled digital readers are self-regulated and do not interact with multimedia without first thinking about the consequences. Successful digital readers construct content meaning because they are able to self-regulate and make appropriate navigational choices within the technological and pedagogical constructs of the digital system (Chifari et al., 2009; Coiro, 2007; Coiro & Dobler, 2007). In contrast, less skilled digital readers will be cognitively overloaded due to their hasty choices and lack of self-regulation (Coiro, 2007). Children who interact more regularly with technology are more comfortable and experience less anxiety when using it (Colley, Gale, & Harris, 1994).

Prior knowledge impacts engagement and contributes to the nonverbal reading experience, but motivation to be engaged is also essential (Sadoski & Paivio, 2007). A reader may understand the cognitive and metacognitive strategies needed to read successfully; however, a reader will not comprehend if he or she does not have the desire to read. Strategic readers need both the skill and the will (Miller & Faircloth, 2009). Motivation is part of the self-regulatory element of metacognition (Baker & Beall, 2009). In order to complete any cognitive task, one must want to evaluate the progress and adjust cognitive strategies if necessary. Readers must exert effort in order to learn to read and grow (Baker & Wigfield, 1999).
Positive attitudes towards reading steadily decreases from first grade to sixth grade (Reinking & Watkins, 2000). However, digital texts can be motivating for young readers and struggling readers. Many studies have found that generally positive effects are related to technology (Blok et. al, 2002; Cassady & Smith, 2005; Greenlee-Moore & Smith, 1994). These positive attitudes may affect the quality of understanding (Chen, 2010). Attitudes towards new technologies are explored further in the upcoming section of this literature review.

The Uniqueness of Touch Screens and iPads

Research related to textual and reader elements appealing to verbal and nonverbal modes has been described in both traditional and digital reading experiences. Similar to visuals and sounds, touch is a nonverbal element of the reading experience. However, recent research has separated touch into a separate and distinct third mode. One reason for distinguishing touch is that it can interact with verbal and nonverbal modes in the form of a touch screen digital text environment. The reading experience of the digital text in the current study has incorporated this third mode, physical touch, and explores how it may influence comprehension. The combination of these three modes: (a) verbal, (b) nonverbal, and (c) touch may influence a reader’s meaning-making process (Walsh, 2006).

IPads may provide a different reading experience than reading a digital text on a computer, such as a CD-ROM text, due to the touch mode. Personal experiences within a text create emotional connections (Rosenblatt, 1978), and digital texts provide personal experiences because readers have to interact with the interface and respond by clicking in certain locations to access video clips or other hyperlinks. CD-ROM texts have been used in several previous studies with young children (Doty et al., 2010; Grimshaw et al., 2007; Korat, 2010; Korat & Shamir, 2008; Labbo & Kuhn, 2000; Segal-Drori et al., 2010), and the CD-ROM text format requires readers to
interact with a text through a keyboard or mouse. However, texts on touch screens eliminate the need for a separation between the reader and the digital text. The reader simply uses a finger to directly touch the text on a screen.

Touch can be an active practice that bridges processes such as reading, problem solving, navigating a text, and thinking about and processing new information (Simpson et al., 2013). The term haptic derives from the Greek meaning “to fasten” and refers to the science of touch and interaction with an environment via touch. Haptic display technologies in education use touch as a means to motivate and increase active participation of students. Haptic technology ranges from complex full-body virtual simulations to stimulating the index finger pad for interaction with digital content (Barfield, 2010). Mangen (2008) extends different tactile interactions and haptic perception to conventional books and digital texts. The physical ways readers interact with texts on a touch screen is distinctly different than clicking a mouse, typing on a three dimensional keyboard, or turning paper pages. The touch screen tends to be intuitive and the unnecessary mouse or three dimensional keyboard usually translates to easier hand-eye coordination (Siegenthaler, Bochud, Wurtz, Schmid, & Bergamin, 2012).

Twelve university students compared three electronic-reading devices: (a) Sony PRS-505, (b) Sony PRS-600, and (c) Apple iPad for various reading functionalities and overall usability. The Sony PRS-600 and Apple iPad were touch screen, and students interacted with text through buttons on the Sony PRS-505. The students rated the two touch screen e-readers as having significantly better navigation and design. Researchers believed some of the high ratings related to the faster feedback time of the touch screen devices (Siegenthaler et al., 2012). Similarly, several research studies have concluded that interacting with an iPad is easy (Dhir, Gahwaji, & Nyman, 2013; Hutchson, Beschorner, & Schmidt-Crawford, 2012; MacLean, Tausky, Labahn,
Lank, & Marzouk, 2011; Ostashewski, Reid, & Ostashewski, 2010). Children have reported that using an iPad is engaging and enjoyable (Culen, & Gasparini, 2011; Jennings, Anderson, Dorset, & Mitchell, 2011).

Touch plays a key role in early learning. Roskos, Burstein, Shang, and Gray (2014) studied 24 preschooler’s text engagement on touch screen digital devices in two settings: (a) a teacher directed small group setting around a desktop touch screen computer, and (b) independent and paired digital text reading on an iPad or iPod. Video analysis showed a significant difference in time spent looking, moving, gesturing, and touching depending on which digital device the student was using. There was also an increase in interactivity with the e-book content through swiping, tapping, dragging, dropping, and pulling material from the digital text. The researchers concluded that the influence of interaction with touch screen digital devices as meaning-making tools was just beginning, and that more research on the impact of learning literacy skills is needed.

Reading on touch screens must account for interactivity as readers manipulate a digital text through gestures and touch. Touch screens provide a blurred distinction between literacy and action, and understanding the impact of touch is still in its infancy (Beavis, 2012; Jewitt, 2009; Walsh & Simpson, 2013). Walsh and Simpson (2013) observed 28 fifth grade students reading on iPads. The researchers noticed constant finger movement when students read. Students were constantly touching, tapping, and sliding to move around the screen or change the font size. The researchers tracked students’ movements and concluded that the reader’s physical engagement with a text is one way to trace internal thought processes. Touch was an added mode of communication along with verbal and nonverbal modes; touch may be a new way of representing meaning.
This tactile difference may influence comprehension, but there is little research measuring reading comprehension using a touch screen interface. The current study builds upon the body of research from haptic touch as well as reading comprehension research in traditional print texts and computer texts.

Current research on iPads has mainly focused on user interest, user affect, and usability. Very few studies have analyzed the relation between touch screens and reading comprehension, although recent studies have shown conflicting results. Some studies have reported that reading on a touch screen device can positively impact reading comprehension (Battenberg & Merbler, 1989; Culen & Gasparini, 2011; Simpson et al., 2013), while other studies have found no impact or a negative impact on reading comprehension when reading on a touch screen (Sheppard, 2011; Wright et al., 2013). The discrepancy of findings may be a result of too few participants, a range of ability of the readers, the diverse tools used to measure reading comprehension, and a mixture of considerate and inconsiderate multimedia.

One of the earliest studies involving touch screens was with 40 children with developed delays and 40 typical children in kindergarten. Children completed two digital alphabetic tasks on a touch screen computer and a computer with a keyboard. Children had to match uppercase and lowercase alphabetic letters on the first task and spell four numerals in French for the second task. Both the children with developed delays and typical children were significantly more successful with the touch screen computer on the matching activity, but the results were inconclusive for the spelling task (Battenberg & Merbler, 1989).

Other case studies have found touch screens positively impact social and academic skills for students with disabilities (Culen & Gasparini, 2011; Jowett, Moore, & Anderson, 2012; McClanahan, Williams, Kennedy, & Tate, 2012). Two case studies using iPads as assistive
technology for students with reading disabilities showed a potential for the touch screens to improve reading comprehension. Cullen and Gasparini (2011) had two children with reading disabilities read two similar texts; one text was read on an iPad, and one text was read on paper. The iPad text was read aloud through the iPad application SpeakText, which had voiceover and highlighted the words as they were read digitally. Students were required to answer eight questions after reading; four questions were recall, and four questions were related to causes and effects in the story. Neither child answered any of the cause and effect questions correctly after reading the paper text, but both children answered at least two of the questions correct after listening to the iPad text. The researchers added that the stigmatization of having a reading disability in a general education class was minimized by using the iPad and building self-confidence. The researchers concluded that more research should be done with larger samples of participants (Culen & Gasparini).

Simpson et al. (2013) observed students’ interactions with iPads and found a close relation between text material and cognitive processes. This two-year-study focused on a mixed methods approach to data collection including videotaping and observing third and fifth grade students using iPads around literacy. Participants worked as partners, and a significant increase in collaboration occurred when using the touch screens. Readers at various ability levels interacted more when using iPads, and mixed-ability pairs were more likely to work together with the iPads than with traditional print texts. The researchers concluded that uses of touch screen technology are promising; yet, they assert that there is a need for further research with touch screen tablets.

In another study of digital texts and comprehension, Wright, Fugett, and Caputa (2013) had three second grade female students independently read a digital text on an iPad and a traditional print text of similar readability. Participants silently read each text and then answered
eight related comprehension questions. Each participant tallied when she used a resource while reading. Digital resources included a thesaurus, pop-up dictionary, and text-to-speech feature embedded in the digital text. Traditional resources included paper versions of a thesaurus, dictionary, and the opportunity to ask the researcher questions. There was an increased number of comprehension questions answered correctly for the traditional text, but the differences were not significant. There was a significantly higher frequency of resources used while reading the digital text on the iPad (Wright et al.).

Sheppard (2011) conducted a study with 43 sixth grade boys reading a text in a traditional print form as well as a text on an iPad. In the repeated measures study, each boy read one novel in each of the two formats. The boys were allowed to annotate in the text, and a posttest was given to determine text comprehension in addition to a general attitudinal survey about reading. The posttest questions were short answer questions assessing the first three levels of Bloom’s taxonomy: (a) knowledge, (b) comprehension, and (c) application. The findings showed that the boys with the lowest reading ability based on the Comprehension Progressive Achievement Test in Reading (PAT-R) scored lower on the knowledge posttest questions when reading the text on the iPad compared to the traditional paper text. Two thirds of all participants had negative or no growth in the knowledge and comprehension questions when reading on the iPad. However, the researcher reported that students were very engaged when using the iPad. Limitations of the study include a small sample size and no pretest to account for prior knowledge.

The current research study design builds strategically upon the previous research. Reading comprehension theories helped to identify textual and reader elements that contribute to verbal and nonverbal modes. Studies with traditional print texts influenced studies with digital
CD-ROM texts. These findings are all influencing current studies with touch screens, and the third distinct mode of touch.

The body of research reviewed has described the textual verbal and textual nonverbal elements that contribute to the reading experience. This research has informed the development of the author-created digital text used in the current study. The digital text used in the study is nonfiction and isolates only one considerate multimedia feature. Table 1 aligns the textual elements in the research to the text, *Vegetables*, used in the current study.

The body of research describing the reader elements also contributes to the reading experience. This research informed the elements that were captured in the current study. Table 2 aligns the reader verbal and reader nonverbal elements in research to the measurements used in the current study. Chapter 3 will further explain the methodology used to achieve these goals.
<table>
<thead>
<tr>
<th>Type</th>
<th>Element</th>
<th>Related Research</th>
<th>How it was incorporated in author-created text <em>Vegetables</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Textual Verbal</td>
<td>Vocabulary difficulty</td>
<td>Anderson &amp; Freebody, 1981; Nagy, 2007; Seigneuric &amp; Ehrlich, 2005</td>
<td>Vocabulary related to crop growth and healthy eating is a typical unit of study in a second grade curriculum, and thus appropriate for the second and third grade participants in the study. Embedded video clips contained images of beets, corn husks, and words that may have been unfamiliar.</td>
</tr>
<tr>
<td></td>
<td>Word choice</td>
<td>Anglin, 1993; Graves, 2006; Nagy &amp; Anderson, 1984</td>
<td>Text contains several plural spellings of nouns, and one noun with a derivational ending turning it to an adjective.</td>
</tr>
<tr>
<td></td>
<td>Considerate text- Text structure</td>
<td>Armbruster &amp; Anderson, 1981</td>
<td>Text comprised of four paragraphs, and each paragraph contained a clear topic sentence and details to support the topic sentence. The main idea and details structure of the paragraphs match the author’s intent to inform readers about healthy eating and how vegetables grow.</td>
</tr>
<tr>
<td></td>
<td>Considerate text- Unification</td>
<td>Armbruster &amp; Anderson, 1981</td>
<td>Text was written with the intent of informing readers around the topics of healthy eating and vegetables. There were no intended distracters embedded in the text.</td>
</tr>
<tr>
<td></td>
<td>Digital narration</td>
<td>Grimshaw et al., 2006; Korat &amp; Shamir, 2008</td>
<td>There was no digital narration of the written text in order to isolate the impact of the embedded multimedia.</td>
</tr>
<tr>
<td>Textual Nonverbal</td>
<td>Considerate dynamic images- Multimedia Principle</td>
<td>Mayer, 2001</td>
<td>Video clips combine visual and verbal elements through voiceovers.</td>
</tr>
<tr>
<td></td>
<td>Considerate dynamic images-Spatial Continuity Principle</td>
<td>Mayer, 2001</td>
<td>Video clips are located on the same digital page as the related written text.</td>
</tr>
<tr>
<td></td>
<td>Considerate dynamic images-Temporal Continuity Principle</td>
<td>Mayer, 2001</td>
<td>Voiceovers correlate with the visual images within the video clips.</td>
</tr>
<tr>
<td></td>
<td>Considerate dynamic images-Coherence Principle</td>
<td>Mayer, 2001</td>
<td>Only relevant information is presented.</td>
</tr>
<tr>
<td></td>
<td>Considerate dynamic images- Modality Principle</td>
<td>Mayer, 2001</td>
<td>Narration of embedded video clips is oral.</td>
</tr>
<tr>
<td></td>
<td>Considerate dynamic images- Redundancy Principle</td>
<td>Mayer, 2001</td>
<td>No written narration is provided; the written text is related, but different than oral narration.</td>
</tr>
<tr>
<td></td>
<td>Considerate dynamic images- Individual Differences Principle</td>
<td>Mayer, 2001</td>
<td>The researcher anecdotally recorded individual reader elements as participants read the text.</td>
</tr>
<tr>
<td>Type</td>
<td>Element</td>
<td>Related Research</td>
<td>How it was captured in the current study</td>
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<tr>
<td>Reader Verbal</td>
<td>Fluency – Accuracy</td>
<td>Rasinski et al., 2011</td>
<td>Participants read aloud a second grade word list and a second grade readability passage in the QRI-5. Accuracy was recorded through the number of errors participants made while reading aloud the word list and passage. Errors were considered deletions, substitutions, and insertions.</td>
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<td></td>
<td>Fluency – Automaticity</td>
<td>Rasinski et al., 2011</td>
<td>The researcher recorded the time participants took to read aloud the isolated words and passage.</td>
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<td></td>
<td>Fluency – Prosody</td>
<td>Rasinski et al., 2011 Wright, Fugett, &amp;</td>
<td>Anecdotal notes by the researcher as participants read aloud. Participants were not given the opportunity to refer back to the text while answering the comprehension questions.</td>
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<td></td>
<td>Comprehension during reading</td>
<td>Caputa, 2013</td>
<td></td>
</tr>
<tr>
<td>Reader Nonverbal</td>
<td>Prior knowledge of hypertext structure</td>
<td>Chan &amp; Unsworth, 2011; Coiro, 2011;</td>
<td>Prior experiences with an iPad were self-reported.</td>
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<td></td>
<td></td>
<td>Coiro &amp; Dobler, 2007</td>
<td></td>
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<td></td>
<td>Prior topic knowledge</td>
<td>Coiro &amp; Dobler 2007; Shin et al., 1994</td>
<td>Participants were asked three concept questions and asked to make a prediction in QRI-5 assessment. Pretest of eight multiple-choice questions prior to reading <em>Vegetables</em>.</td>
</tr>
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<td></td>
<td>Motivation</td>
<td>Baker &amp; Beall, 2009</td>
<td>Researcher noted if the participants discontinued reading prior to the end of the passage.</td>
</tr>
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<td></td>
<td>Enjoyment</td>
<td>Culen &amp; Gasparini, 2011; Jennings et al.,</td>
<td>Participants were surveyed regarding their feelings about reading on the iPad compared to a traditional book including which platform they liked better, thought was more fun, and was easier.</td>
</tr>
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<td></td>
<td></td>
<td>2011</td>
<td></td>
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</table>
Chapter 3

The current study analyzed how various digital text elements and reader elements impact reading comprehension of a digital text. The digital text was originally created by the researcher. A description of the creation of the text, *Vegetables*, is described below. A description of the digital comprehension research study is following. The intended data analysis is described at the conclusion of this chapter.

**Authoring Digital Texts**

The researcher authored two versions of the digital text, *Vegetables*, using the iBooks Author program. One version did not have any nonverbal textual elements to support comprehension; this version will be identified as *Vegetables* without Videos (VwoV). The second version had embedded nonverbal considerate textual elements to support comprehension; this version will be identified as *Vegetables* with Videos (VwV). The written words of the text were modeled from the second grade Qualitative Reading Inventory-5 (QRI-5) passage, *Seasons* (Leslie & Caldwell, 2011) (see Appendix A) and various leveling systems and readability formulas were considered. The goal of writing the text was to use a second grade appropriate text that aligned to the current unit of study but was unfamiliar to all students. By creating a new text, it was very likely that the exposure to the text in the study was the first time participants had interacted with it.

The transcript of the written words in the digital texts, *Vegetables*, (see Appendix B) is determined to be a level M text according to Fountas and Pinnell (2011) leveling system, a Harris-Jacobson (Harris & Sipay, 1990) readability level of 2.4, and a Fry readability of second grade (Fry, 1977). Readability formulas can provide an indication of overall complexity, but there are limitations to readability formulas. First, content vocabulary of repeated multi-syllabic
words can falsely inflate readability. The text contains 230 words and 78.7% of the words are monosyllabic. The three-syllable word “vegetables” is repeated in the digital text eight times. Additionally, artificially shortening sentences or combining sentences with a conjunction can skew readability (Hiebert & Mesmer, 2013). These limitations were taken into account by closely mirroring the number of syllables in each sentence of the QRI-5 passage, Seasons, when writing the “Vegetable” text instead of the overall number of syllables in the passage.

The written words of the Vegetables text were then dispersed across eight digital pages using the iBook Author program. Each page contained two to five related sentences. Descriptors of a level M text appropriate for second grade include “ample space between lines” and “many sentences continuing over several lines” (Fountas & Pinnell, 2011, p.301). The font was large and located at the bottom of each page.

A title page with a picture of vegetables was added, and a large stop sign was included after the text to remind readers to stop before continuing. One posttest multiple-choice question was added to each of the following eight pages. A graphic with confetti and ribbon was at the end of the posttest questions with encouragement to share about participants’ reading experiences. One of each of the four multiple choice questions were on the last four pages of the text.

Two practice pages were added to the beginning of the text. The first page included information about a character learning to dance, and the second page included a multiple choice question related to the practice page.

Both versions of the text, VwoV (see Appendix C) and VwV (see Appendix D) were identical except that the VwV version included one short video clip on each page with written words of the text Vegetables. The researcher edited existing Discovery Education video clips
that were intended for replication for educational use. Video clips ranged from 9 seconds to 27 seconds. Each video clip included both visual and auditory information. The original voiceover was used with six video clips, and the author created original voiceover for two video clips. Each video clip was directly related to the written text on the page and located directly above the written text.

**Comprehension Research Study**

**Participants.** Second and third grade students that participated in a general education literacy class were invited to participate in the study. Second grade students \((n = 100)\) and third grade students \((n = 115)\) at the same large urban elementary school were invited and were able to participate in the study after returning a signed parent/guardian permission form (see Appendix E).

**Setting.** Claire Elementary is a large elementary school located in an urban school district in a mid-sized Mid Atlantic city. Claire Elementary served 763 kindergarten through fifth grade students for the 2013-2014 school year. 95.0% of the student population were black or African American. The student attendance rate was 91.7%. Students receiving Free and Reduced Meals (FARMS) were greater than 95.0% of the student population.

Each grade level in the school had four to five general education classes. There were four second grade classrooms and five third grade classrooms; all similar grade level classrooms were clustered together in the same hallway. The second and third grade teachers were not departmentalized, and students remained with the same teacher throughout all core content subject areas. Students rotated teachers for the fine art classes and weekly computer lab class.

Two to three classroom desktop computers were located in each classroom with varying degrees of functionality and capacity. A laptop cart with student laptops \((n = 35)\) was shared
among the second and third grade classes. Two computer labs with student computers \( (n = 50) \) were located in close proximity to the second and third grade classrooms. Students had weekly computer lab classes with the technology teacher. The school did not have any iPads or touch screen tablets for teachers or students.

**Variables.** Independent and dependent variables have been identified in order to address the overarching research question. Three independent variables include: (a) reading ability, (b) prior knowledge of reading content, and (c) reading a text with or without embedded considerate video clips. The dependent variable is the posttest comprehension score. Descriptive variables were also collected (see Table 3).

Table 3

<table>
<thead>
<tr>
<th>Variables of Interest</th>
<th>Indicator</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent Variables</td>
<td>Reading Ability</td>
<td>QRI-5 passage</td>
</tr>
<tr>
<td></td>
<td>• Word list</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Concept Questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Predictions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Miscues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Retell</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Explicit Comprehension Questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Implicit Comprehension Questions</td>
<td></td>
</tr>
<tr>
<td>Prior Knowledge of Reading Content</td>
<td>Pretest</td>
<td></td>
</tr>
<tr>
<td>Text with or without videos</td>
<td>Experiment or Control Group</td>
<td></td>
</tr>
<tr>
<td>Dependent Variables</td>
<td>Digital Text Comprehension</td>
<td>Posttest</td>
</tr>
<tr>
<td>Descriptive Variables</td>
<td>Demographics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Grade</td>
<td>Classroom</td>
</tr>
<tr>
<td></td>
<td>• Gender</td>
<td></td>
</tr>
<tr>
<td>Time To Read QRI-5</td>
<td>QRI-5</td>
<td></td>
</tr>
<tr>
<td>Time Spent Reading Digital Text</td>
<td>Researcher Notes</td>
<td></td>
</tr>
<tr>
<td>Previous Ipad Experience</td>
<td>Self-report</td>
<td></td>
</tr>
<tr>
<td>Ipad Attitudes</td>
<td>Self-report</td>
<td></td>
</tr>
</tbody>
</table>

**Procedure.** The researcher obtained permission from the district and the principal of Claire Elementary school to conduct the study with willing student volunteers from classes with
willing teacher volunteers. The researcher met with second grade teachers \((n = 4)\) and third grade teachers \((n = 5)\) in grade-level team meetings to describe the study, answer questions, and request volunteers. All nine teachers were general education homeroom teachers, and most teachers \((n = 7)\) had special education inclusion students in their general education literacy class. 100% \((n = 9)\) of the teachers agreed to participate.

The researcher visited each second and third grade classroom and explained the study, answered questions, read the verbal assent (see Appendix F), and distributed parent permission forms (see Appendix E) to all interested students. Teachers were provided with a brightly colored two-pocket folder with additional copies of the parent permission forms, a copy of the verbal assent, and a tentative schedule for individual participant and researcher meetings. Teachers collected the signed parent permission forms, and the researcher collected forms from teachers after 12 school days and 22 school days.

**Individual pretest phase.** The researcher met with each participant individually for the first phase of data collection. The participant and researcher met in a separate empty space close in proximity to all second and third grade classrooms. The space was quiet, and both the researcher and participant sat next to each other at a table.

During this individual phase, the participants completed three measures: Qualitative Reading Inventory-5 (QRI-5), (b) Pretest, and (c) iPad Experience Self-Report. Each individual meeting was about 20 minutes in length. At the conclusion of the meeting, the researcher requested that the participant return to class and send another student.

The QRI-5 (Leslie & Caldwell, 2011) is an individually administered reading inventory comprised of several subtests. The QRI-5 has an inter-judge reliability score of 98 percent. It
also has internal consistency, reliability, and content validity. Both the QRI-5 word list and the passage participants read were on an iPad.

The researcher first asked participants to read a list of second grade level words \((n = 20)\) to determine the participant’s ability to decode words in isolation (see Appendix A). The researcher then determined if the second grade expository text, *Seasons*, was familiar or unfamiliar to the participant based on concept questions before reading the passage. The participant then read the passage aloud as the researcher timed the reading and marked any miscues (word substitutions, omissions, insertions, repeated words). Each miscue was only recorded once. For example, if a participant substituted the word *winter* for *weather*, but then self-corrected himself or herself, the error only counted as a self-correction and not as a substitution. When a participant stopped reading before reaching the end of the passage by voicing they were finished or signaling they were not going to continue reading, the words not read from the stopping point to the end of the passage were counted as deletion miscues.

The QRI-5 Accuracy Miscues variable was calculated by combining the deletions, substitutions, insertions, and self-corrections. In accordance with guidance from Leslie and Caldwell (2011), repetitions, hesitations, and omission of punctuation were not included in the Accuracy Miscue variable. The passage contained 247 words total.

Leslie and Caldwell (2011) describe acceptability miscues as “those that do not change or distort passage meaning” (p. 63) either semantically or syntactically. The researcher used Leslie and Caldwell’s (2011) guidance for determining Acceptability Miscues for each deletion, substitution, or insertion miscue. Self-corrections were never included in the Acceptability Miscue variable.
In order to summarize the Acceptability Miscues, the researcher recoded this variable into three intervals. The passage was 247 words, and 5% of errors would yield 12.35 miscues. Therefore, participants with 0 to 12 Acceptability Miscues (95.14% to 100.00% acceptability) were categorized as high decoding ability. Participants with 13 to 25 Acceptability Miscues (89.88% to 94.74% acceptability) were categorized as mid decoding ability. Participants with 26 or greater Acceptability Miscues (< 89.47% acceptability) were categorized as low decoding ability. These intervals to describe decoding ability were used in conjunction with comprehension ability in order to ultimately determine the reading level of a participant as described in Figure 2.

Participants were given as much time as necessary to complete the reading. The researcher then asked the participants to retell as many details as he or she could remember from the text after reading. The researcher also orally asked implicit (n = 4) and explicit (n = 4) comprehension questions about the text to which participants gave a verbal response (see Appendix A).

In order to summarize the QRI-5 Total Comprehension, the researcher recoded this variable into three intervals. There were a possible comprehension eight questions, so two questions were worth 25.00% of the total. Therefore, participants correctly answering 0 to 2 comprehension questions (< 25.00% correct) were categorized as low comprehending ability. Participants correctly answering 3 or 4 comprehension questions (37.50% to 50.00% correct) were categorized as mid comprehending ability. Participants correctly answering 5 to 8 comprehension questions (62.50% to 100.00% correct) were categorized as high comprehending ability. These intervals to describe comprehension ability were used in conjunction with
intervals to describe decoding ability from the Acceptability Miscues in order to ultimately
determine the Reading Level of a participant as described in Figure 2.

Participants overall Reading Level was determined based on the Acceptability Miscues
and the Total Comprehension similar to Leslie and Caldwell’s (2011) guidelines for determining
total passage level (p.58). The guidelines described in Figure 2 were used to determine Reading
Level.

*Figure 2. Guidelines to determine Reading Ability.*
An eight question multiple choice pretest was also administered on the iPad. Each question was worth one point and modeled from the QRI-5 comprehension questions. The pretest questions and four possible answer choices were read aloud to participants to measure overall comprehension and not the ability to decode words. Participants were taught how to choose their answer by tapping the touch screen and highlighting their answer (see Appendix G).

The third measure at the individual meeting was the student self-report of iPad Experience. Participants were asked about their previous experiences with iPads and purposes for using iPads. The three questions were on the iPad and the researcher read aloud the questions and answers. Participants selected their response(s) by tapping the touch screen and highlighting their answer. This descriptive data will be used to understand the overall sample population’s experiences with iPads (see Appendix H).

**Small group phase.** The researcher met with groups of four to ten participants for the second phase of data collection after all participants had completed the individual phase. Each small group of participants was the same grade level. The groups were assigned to one of the two versions of the text *Vegetables*. Participants in the same homeroom read the same version of the text.

The participants and researcher met in a separate empty classroom close in proximity to all second and third grade classrooms. The door remained closed, but typical hallway noise was heard. The room had a large table for students to receive initial instructions, and individual desks for students to sit during the reading time.

During this small group phase, the participants completed three measures: (a) Independent Reading of *Vegetables*, (b) Posttest, and (c) iPad Feelings Self-Report. Each small group meeting was about 20 minutes in length.
Prior to completing the measures, participants gathered around a large table. The researcher presented a mini-lesson on how to use an iPad (see Appendix I), reviewed the iPad rules (see Figure 3), and distributed individual iPads and headphones to each participant (see Figure 4).

Figure 3. Ipad rules were discussed in the mini-lesson and hung in the classroom during the independent reading.

Figure 4. Each participant was given an individual iPad and headphones with the digital text.

Upon receiving individual iPads, the researcher guided participants through reading the practice page and answering the practice question. The researcher used a checklist to identify if participants were able to: (a) turn a digital page, (b) view embedded multimedia, (c) listen to a test question read aloud, and (d) tap and highlight to choose an answer to a test question. Each
participant had to demonstrate proficiency in the above tasks in order to use the iPad (see Appendix J).

Participants then independently, silently read one version of the text *Vegetables* on individual iPads at a desk. Participants in the control classes read the VwoV, and students in the treatment classes read the VwV (see Table 4). The researcher recorded how long it took students to read the text, and anecdotal notes while participants were reading (see Appendix J).

Table 4

<table>
<thead>
<tr>
<th>Class</th>
<th>Control: <em>Vegetables</em> without Video (VwoV)</th>
<th>Treatment: <em>Vegetables</em> with Video (VwV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 2, Group A</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Grade 2, Group B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 2, Group C</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Grade 2, Group D</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Grade 2, Group E</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Grade 3, Group F</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Grade 3, Group G</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Grade 3, Group H</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Grade 3, Group I</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Grade 3, Group J</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Posttest.* After all participants in the small group completed reading the text *Vegetables* independently, the researcher read aloud the posttest questions and possible answers. The posttest questions were the same eight questions as the pretest in a different order (see Appendix K). Participants listened to the question and four possible answers before tapping and highlighting their chosen answer. When answering the posttest questions, participants were not
allow to refer back to the text. Participants were allowed to ask for the question or answers to be repeated, and all participants did not move on to the next question until everyone was ready.

The third measure at the small group phase was the student self-report of iPad Feelings. Participants were asked to compare reading on an iPad with reading traditional paper texts. The four questions were on the iPad and the researcher read aloud the questions and answers. Participants selected their response by tapping the touch screen and highlighting their answer. This descriptive data will be used to understand the overall sample population’s feelings towards reading on iPads compared to reading paper texts (see Appendix L).

At the conclusion of the study, each participant received a traditional paper text. The grade-level teachers chose a text for all students based on interest and class activities. There was also a drawing for a class pizza party. The principal chose one second grade participant and one third grade participant randomly to earn a pizza party for his/her entire class.

**Design and analysis.** Participants were grouped based on their ability to read the expository level two passage from the QRI-5 as low, middle, or high reading level. This was one scaled independent variable. Group assignment to either VwoV or VwV was the second categorical independent variable. The pretest score for the Vegetables passage determined prior knowledge and was the third independent variable. The posttest comprehension score was the dependent variable. A factorial ANOVA and multiple regression were conducted using the Statistical Package for Social Sciences (SPSS).
Chapter 4

The findings of this study are a result of data collected using methodology described in Chapter 3. The purpose of the study was to explore possible impacts of particular multimedia unique to digital texts on the reading comprehension of young elementary school students through a pretest posttest quasi-experimental design. Participants in the same homeroom class were randomly assigned to read an expository text, *Vegetables*, on an iPad either with or without embedded video clips. Prior to reading the text independently on the iPad, each student individually read the expository second grade QRI-5 passage, *Seasons*, aloud to the researcher and completed associated tasks including the concept questions, predictions, retell, and comprehension questions. Students were also individually asked pretest questions related to the *Vegetables* text.

This chapter will present the results of the analyses selected to address the research questions. It will begin with a description of the participants in treatment and control groups. Results of statistical analyses using SPSS statistical program will then be presented for the following three research questions:

1.0 Do participants in the treatment group (VwV) and control group (VwoV) score similarly on preintervention reading characteristics?

2.0 Do embedded considerate video clips and Reading Ability impact reading comprehension as measured by a posttest?

3.0 Will the variable set of reading ability, prior knowledge of reading content, and reading a digital text with or without embedded considerate video clips predict to digital reading comprehension in early elementary children?
Qualitative data collected through self-reporting surveys related to previous experiences with iPads and attitudes towards iPads after participating in the study will be described at the end of the chapter.

**Description of Participants**

There were 150 second and third grade students recruited for the study. A total of 91 students returned the parent permission slip, but one student transferred schools between collection of permission slips and the beginning of the study. All 90 students that began the study completed both the individual phase and the small group phase; there were no missing data. The researcher randomly assigned participants from the same homeroom classes to either the treatment group reading Vegetables with Videos (VwV) or the control group reading Vegetables without Videos (VwoV).

A total of 39 males and 51 females participated in the study (see Table 5). A total of 46.66% ($n = 42$) of participants were in the second grade and 53.33% ($n = 48$) were in the third grade. There were a total of 46 students in the treatment group and 44 students in the control group. Gender and grade distribution between groups was tested using the SPSS Crosstabs program and Chi-Square statistic assuming equal probabilities. Results of the Chi Square indicated no significant difference between group assignment for gender [$\chi^2 (1, N = 90) = .001, p > 05$]. Results of a Chi Square indicated no significant difference between group assignment for grade [$\chi^2 (1, N = 90) = 3.67, p > 05$].

Students’ reading ability levels were determined as a result of the variables collected and analyzed related to the QRI-5 passage (see Figure 2). The low ability readers were 47.78% ($n = 43$) of the study population, and 15.56% ($n = 14$) of students were high ability readers. Results
of a Chi Square indicated a significant difference between group assignment for Reading Ability 
$\chi^2 (2, N = 90) = 6.83, p < 05$.

The frequencies and percents of gender, grade level, and reading ability level by group are shown below in Table 5.

Table 5

*Frequencies of Gender, Grade Level, and Reading Level in Groups and Total Study Population*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment (VwV)</th>
<th>Control (VwoV)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>20 (43.48)</td>
<td>19 (43.18)</td>
<td>39 (43.33)</td>
</tr>
<tr>
<td>Female</td>
<td>26 (56.52)</td>
<td>25 (56.82)</td>
<td>51 (56.66)</td>
</tr>
<tr>
<td>Total</td>
<td>46 (100.00)</td>
<td>44 (100.00)</td>
<td>90 (100.00)</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Grade</td>
<td>26 (56.52)</td>
<td>16 (36.36)</td>
<td>42 (46.66)</td>
</tr>
<tr>
<td>3rd Grade</td>
<td>20 (43.48)</td>
<td>28 (63.64)</td>
<td>48 (53.33)</td>
</tr>
<tr>
<td>Total</td>
<td>46 (100.00)</td>
<td>44 (100.00)</td>
<td>90 (100.00)</td>
</tr>
<tr>
<td>Reading Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Ability</td>
<td>10 (21.74)</td>
<td>4 (9.09)</td>
<td>14 (15.56)</td>
</tr>
<tr>
<td>Mid Ability</td>
<td>20 (43.48)</td>
<td>13 (29.55)</td>
<td>33 (36.67)</td>
</tr>
<tr>
<td>Low Ability</td>
<td>16 (34.78)</td>
<td>27 (61.36)</td>
<td>43 (47.78)</td>
</tr>
<tr>
<td>Total</td>
<td>46 (100.00)</td>
<td>44 (100.00)</td>
<td>90 (100.00)</td>
</tr>
</tbody>
</table>

**Pretest Phase**

During the pretest phase, the QRI-5 and the Vegetables pretest were administered to each student individually by the researcher. The individual phase yielded nine variables to describe each participant as a reader: (a) QRI-5 Word List Score, (b) QRI-5 Total Concept Questions
Score, (c) QRI-5 Predictions Score, (d) QRI-5 Accuracy Miscues, (e) QRI-5 Acceptability Miscues, (f) QRI-5 Total Comprehension Score, (g) QRI-5 Retell Score, (h) QRI-5 Time, and (i) Vegetable Pretest Score. The mean and standard deviation of each variable was determined by group and the total study population. SPSS Independent-Samples T Test program was used to compare groups on each variable in order to determine similarities and differences between the treatment and control group. The Confidence Interval was set at 95% (see Table 6).

Research Question 1

This research question investigated whether participants in the treatment group (VwV) scored significantly different from participants in the control group (VwoV) on preintervention standardized reading characteristics. This question was investigated through nine subhypotheses related to QRI-5 subscales.

Research Question

1.0 Do participants in the treatment group (VwV) and control group (VwoV) score similarly on preintervention reading characteristics?

Research Hypotheses

1.1 Participants in the treatment group will not score significantly different from participants in the control group on the QRI-5 Word List Score.

1.2 Participants in the treatment group will not score significantly different from participants in the control group on the QRI-5 Total Concept Questions Score.

1.3 Participants in the treatment group will not score significantly different from participants in the control group on the QRI-5 Predictions Score.

1.4 Participants in the treatment group will not score significantly different from participants in the control group on the QRI-5 Accuracy Miscues.
1.5 Participants in the treatment group will not score significantly different from participants in the control group on the QRI-5 Acceptability Miscues.
1.6 Participants in the treatment group will not score significantly different from participants in the control group on the QRI-5 Total Comprehension Score.
1.7 Participants in the treatment group will not score significantly different from participants in the control group on the QRI-5 Retell.
1.8 Participants in the treatment group will not score significantly different from participants in the control group on the QRI-5 Time.
1.9 Participants in the treatment group will not score significantly different from participants in the control group on the Vegetable Pretest Score.
Table 6

**Means, Standard Deviations, and Results of Independent T-tests of Variables Among Groups and Total Study Population**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment (VwV)</th>
<th>Control (VwoV)</th>
<th>Total Study Population</th>
<th>t statistic</th>
<th>Difference Between Means</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>t (df)</td>
<td></td>
<td>LL</td>
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<tr>
<td><strong>QRI-5 Related Variables</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QRI-5 Word List</td>
<td>16.20 (4.12)</td>
<td>11.66 (6.04)</td>
<td>13.98 (5.60)</td>
<td>4.15 (75.50)*</td>
<td>4.54</td>
<td>2.36</td>
</tr>
<tr>
<td>QRI-5 Total Concept Questions</td>
<td>5.87 (1.50)</td>
<td>5.41 (1.69)</td>
<td>5.64 (1.60)</td>
<td>1.37 (88)</td>
<td>.46</td>
<td>-.21</td>
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<tr>
<td>QRI-5 Prediction</td>
<td>2.35 (1.40)</td>
<td>2.41 (1.34)</td>
<td>2.38 (1.36)</td>
<td>-.21 (88)</td>
<td>-.06</td>
<td>-.64</td>
</tr>
<tr>
<td>QRI-5 Total Accuracy Miscues</td>
<td>21.20 (34.11)</td>
<td>52.16 (62.54)</td>
<td>36.33 (52.16)</td>
<td>-2.90 (65.85)*</td>
<td>30.96</td>
<td>-52.30</td>
</tr>
<tr>
<td>QRI-5 Total Acceptability Miscues</td>
<td>14.04 (33.75)</td>
<td>42.73 (62.79)</td>
<td>28.07 (51.85)</td>
<td>-2.68 (65.29)*</td>
<td>-26.68</td>
<td>-50.04</td>
</tr>
<tr>
<td>QRI-5 Total Comprehension Questions</td>
<td>3.15 (1.80)</td>
<td>2.36 (1.48)</td>
<td>2.77 (1.69)</td>
<td>2.26 (88)</td>
<td>.79</td>
<td>.10</td>
</tr>
<tr>
<td>QRI-5 Retell</td>
<td>8.61 (4.84)</td>
<td>5.55 (3.74)</td>
<td>7.11 (4.58)</td>
<td>3.37 (84.30)*</td>
<td>3.06</td>
<td>1.25</td>
</tr>
<tr>
<td>QRI-5 Time (in seconds)</td>
<td>193.63 (66.93)</td>
<td>249.02 (130.51)</td>
<td>220.71 (106.16)</td>
<td>-2.52 (63.51)*</td>
<td>-55.39</td>
<td>-9.37</td>
</tr>
<tr>
<td><strong>Vegetables Related Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest Questions</td>
<td>3.91 (1.26)</td>
<td>3.73 (1.26)</td>
<td>3.82 (1.26)</td>
<td>.70 (88)</td>
<td>.19</td>
<td>-.34</td>
</tr>
</tbody>
</table>

*Note. LL = lower limit, UL = upper limit; *p < .05
1.1 QRI-5 Word Lists. Research hypothesis 1.1 stated participants in the treatment group would not score significantly different from the control group on the QRI-5 Word List subscale. Means and standard deviations for groups are presented in Table 6. Results of a $t$ test for independent samples indicated a significant difference between groups, $t(75.50) = 4.15, p < .05$. The difference between means was $4.54$ (CI$_{95}$: 2.36 to 6.72).

Research hypothesis 1.1 was not supported.

1.2 QRI-5 Total Concept Questions. Research hypothesis 1.2 stated participants in the treatment group would not score significantly different from the control group on the QRI-5 Total Concept Questions subscale. Sample responses with scoring from the study are listed in Table 7. Means and standard deviations for groups are presented in Table 6. Results of a $t$ test for independent samples indicated no significant difference between groups, $t(88) = 1.37, p > .05$. The difference between means was $.46$ (CI$_{95}$: -.21 to 1.13).

Research hypothesis 1.2 was supported.
### Table 7

**QRI-5 Concept Questions and Sample Answers with Scores**

<table>
<thead>
<tr>
<th>Rubric</th>
<th>QRI-5 Concept Questions</th>
<th>QRI-5 Concept Questions</th>
<th>QRI-5 Concept Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What do flowers need to grow?</td>
<td>What does &quot;forest animals in the winter&quot; mean to you?</td>
<td>What does &quot;changing seasons&quot; mean to you?</td>
</tr>
<tr>
<td>3</td>
<td>Precise definition, answer specifically related to content or synonym</td>
<td>soil, sunlight, &amp; water</td>
<td>They need to have food when they wake up for spring from hibernating, and they need to eat healthy.</td>
</tr>
<tr>
<td>2</td>
<td>Example of the concept or specific attribute defining characteristics or a function</td>
<td>from a seed</td>
<td>frogs, deers, beavers, wolves, fox, snow owl, gray fox</td>
</tr>
<tr>
<td>1</td>
<td>General association or isolation of prefix/suffix/root word or personal associations</td>
<td>Petals</td>
<td>I like winter because I like snow.</td>
</tr>
<tr>
<td>0</td>
<td>Sound-alikes or unconnected response or “I don’t know”</td>
<td>I don’t know</td>
<td>I don’t know</td>
</tr>
</tbody>
</table>

**1.3 QRI-5 Predictions.** Research hypothesis 1.3 stated participants in the treatment group would not score significantly different from the control group on the QRI-5 Predictions subscale. Means and standard deviations for groups are presented in Table 6. Results of a $t$ test for independent samples indicated no significant difference between groups, $t(88) = -0.21, p > .05$. The difference between means was -.06 (CI<sub>.95</sub>: -.64 to .51).

Research hypothesis 1.3 was supported.
1.4 QRI-5 Accuracy Miscues. Research hypothesis 1.4 stated participants in the treatment group would not score significantly different from the control group on the QRI-5 Accuracy Miscues subscale. Means and standard deviations for groups are presented in Table 6. Results of a $t$ test for independent samples indicated a significant difference between groups, $t (65.85) = -2.90, p < .05$. The difference between means was $30.96$ (CI$_{95}$: $-52.30$ to $-9.63$).

Research hypothesis 1.4 was not supported.

1.5 QRI-5 Acceptability Miscues. Research hypothesis 1.5 stated participants in the treatment group would not score significantly different from the control group on the QRI-5 Acceptability Miscues subscale. Means and standard deviations for groups are presented in Table 6. Results of a $t$ test for independent samples indicated a significant difference between groups, $t (65.29) = -2.68, p < .05$. The difference between means was $-28.68$ (CI$_{95}$: $-50.04$ to $-7.33$).

Research hypothesis 1.5 was not supported.

1.6 QRI-5 Total Comprehension. Research hypothesis 1.6 stated participants in the treatment group would not score significantly different from the control group on the QRI-5 Total Comprehension subscale. Means and standard deviations for groups are presented in Table 6. Results of a $t$ test for independent samples indicated no significant difference between groups, $t (88) = 2.26, p > .05$. The difference between means was $.79$ (CI$_{95}$: $.10$ to $1.48$).

Research hypothesis 1.6 was supported.

1.7 QRI-5 Retell. Research hypothesis 1.7 stated participants in the treatment group would not score significantly different from the control group on the QRI-5 Retell subscale. Means and standard deviations for groups are presented in Table 6. Results of a $t$ test for
independent samples indicated a significant difference between groups, \( t (84.30) = 3.37, p < .05 \).
The difference between means was 3.06 (CI$_{95}$: 1.25 to 4.87).

Research hypothesis 1.7 was not supported.

1.8 QRI-5 Time. Research hypothesis 1.8 stated participants in the treatment group would not score significantly different from the control group on the QRI-5 Time subscale. Means and standard deviations for groups are presented in Table 6. Results of a \( t \) test for independent samples indicated a significant difference between groups, \( t (63.51) = -2.52, p < .05 \).
The difference between means was -55.39 (CI$_{95}$: -9.37 to -11.41).

Research hypothesis 1.8 was not supported.

1.9 Vegetable Pretest Score. Research hypothesis 1.9 stated participants in the treatment group would not score significantly different from the control group on the Vegetable Pretest Score. Means and standard deviations for groups are presented in Table 6. Results of a \( t \) test for independent samples indicated no significant difference between groups, \( t (88) = .70, p > .05 \).
The difference between means was .19 (CI$_{95}$: -.34 to .72).

Research hypothesis 1.9 was supported.

Research Question 2

This research question investigated whether participants in the treatment group (VwV) scored significantly different from participants in the control group (VwoV) in the Vegetables Posttest. The question further investigated whether Reading Ability significantly impacted the Vegetables Posttest Score. Additionally, this question investigated whether participants in the treatment group scored significantly different depending on Reading Ability.

Research Question
2.0 Do embedded considerate video clips and Reading Ability impact digital reading comprehension as measured by a posttest?

Research Hypothesis

2.0 There will be a significant difference in Posttest Scores depending on Reading Ability and treatment.

The research hypothesis was tested using a factorial ANOVA.

Homogeneity of variance was assumed based on Levene’s Test of Equality of Error Variances conducted in the SPSS statistical program. Results of evaluation of the assumptions of normality of sampling distributions and linearity were also satisfactory. Means and standard deviations may be found in Table 8.

Results of the ANOVA are shown in Table 9. A significant main effect was found for Reading Ability, $F(2, 84) = 11.54, p < .001$. There was no significant main effect for Group, $F(1, 84) = 2.55, p > .05$ or interaction of Group by Reading Ability, $F(2, 84) = .66, p > .05$. Post hoc estimates of differences for Reading Ability indicated the High Ability readers and Mid Ability readers scored significantly higher than the Low Ability readers. There were no other significant differences.

Research hypothesis 2.0 was supported.
Table 8

*Means and Standard Deviations of Vegetables Posttest Score, Reported by Group and Reading Ability.*

<table>
<thead>
<tr>
<th>Reading Ability</th>
<th>Treatment</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>High Ability</td>
<td>6.80 (1.03)</td>
<td>5.50 (1.73)</td>
<td>6.43 (1.34)</td>
</tr>
<tr>
<td>Mid Ability</td>
<td>6.35 (1.04)</td>
<td>6.23 (1.54)</td>
<td>6.30 (1.24)</td>
</tr>
<tr>
<td>Low Ability</td>
<td>4.88 (1.96)</td>
<td>4.48 (1.55)</td>
<td>4.63 (1.70)</td>
</tr>
<tr>
<td>Total</td>
<td>5.93 (1.61)</td>
<td>5.09 (1.72)</td>
<td>5.52 (1.71)</td>
</tr>
</tbody>
</table>

Table 9

*Results of Factorial ANOVA, Investigating Effect of Treatment and Reading Ability on Vegetables Posttest Score.*

<table>
<thead>
<tr>
<th>Source</th>
<th>Df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>1</td>
<td>5.70</td>
<td>2.55</td>
</tr>
<tr>
<td>Reading Ability</td>
<td>2</td>
<td>25.82</td>
<td>11.54*</td>
</tr>
<tr>
<td>Interaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group x Reading Ability</td>
<td>2</td>
<td>1.47</td>
<td>.66</td>
</tr>
<tr>
<td>Error</td>
<td>84</td>
<td>2.24</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: *p < .001
Research Question 3

This research question investigated whether participants’ pretest reading characteristics and exposure to the treatment group (VwV) could predict to their Vegetables Posttest Score.

Research Question

3.0 Will the variable set of reading ability, prior knowledge of reading content, and reading a digital text with or without embedded considerate video clips predict to digital reading comprehension in early elementary children?

Research Hypothesis

3.0 The variable set of reading ability, prior knowledge of reading content, and reading a digital text with or without embedded considerate video clips will predict to digital reading comprehension in early elementary children.

A standard multiple regression was performed between the Vegetable Posttest as the dependent variable and the variable set of Group, Reading Ability, and Vegetables Pretest. Analysis was performed using SPSS regression and SPSS Frequencies for evaluation of assumptions. Evaluation of variables indicated statistical assumptions had been met.

Table 10 displays the correlations between variables, the unstandardized regression coefficients ($\beta$) and intercept, the standardized regression coefficients ($b$), the squared semipartial correlations ($sr^2$), $R^2$, and adjusted $R^2$.

A Spearman correlation coefficient was determined using the SPSS Correlation program for relationships between Reading Ability and Vegetables Pretest and Posttest with a significance level set at 0.05 ($p < .05$). A negative significant relationship was found between Reading Ability and Vegetables Pretest, $r = -.42$, $p < .001$. A negative significant relationship was also found between Reading Ability and Vegetables Posttest, $r = -.48$, $p < .001$. 

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The independent variable set consisted of Group, Reading Ability, and Vegetable Pretest Score. $R$ for regression was significantly different from zero, $F(3, 86) = 16.21, p < .001$, indicating that the variable set did influence $R$. The variables Reading Ability and Vegetables Pretest contributed significantly to prediction of Vegetables Posttest (unique variability, $sr^2 = .19$). The three variables in combination contributed another .15 in shared variability. These results indicate that 36% (34% adjusted) of the variability in Vegetables Posttest Score was predicted by knowing the values of these three variables.

The research hypothesis 3.0 was supported.

Table 10

*Standard Multiple Regression Results of Group Assignment, Reading Ability, and Pretest on Posttest Score.*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Posttest Score (DV)</th>
<th>Reading Ability</th>
<th>Group</th>
<th>Pretest Score</th>
<th>$\beta$</th>
<th>$b$</th>
<th>$sr^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Ability</td>
<td>-.48***</td>
<td></td>
<td></td>
<td></td>
<td>-.63</td>
<td>-.27</td>
<td>.06**</td>
</tr>
<tr>
<td>Group</td>
<td>-.25**</td>
<td>.27**</td>
<td></td>
<td></td>
<td>-.50</td>
<td>-.15</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>.51***</td>
<td>-.42***</td>
<td>.07</td>
<td></td>
<td>.54</td>
<td>.40</td>
<td>.13***</td>
</tr>
<tr>
<td>Means</td>
<td>5.52</td>
<td>2.32</td>
<td>1.49</td>
<td>3.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Deviations</td>
<td>1.71</td>
<td>.73</td>
<td>.50</td>
<td>1.26</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$R^2 = .36^a$

Adjusted $R^2 = .34^{**}$

$R = .60$

$p < .05; ** p < .01; *** p < .001$

$^a$unique variability = .19; shared variability = .15
Qualitative Responses

As part of the current study, participants were asked three questions related to their previous experience with iPads during the pretest phase. After the posttest, students were asked four questions regarding their attitudes towards iPads for reading. Data collected regarding the three questions related to previous experiences with iPads will be presented first followed by the attitude responses.

The three questions related to previous experiences with iPads and answer choices were read to the participant during the pretest phase, and participants highlighted their answer. The questions were (a) Which statement best describes your experience with iPads? (b) Does someone in your house own an iPad? and (c) If you have used an iPad before, what have you used it for? Participants who reported “I have never used an iPad before” on the first question, did not receive the third question prompt. These responses may provide a deeper understanding of the participants’ experiences within the study.

Participants were asked “Which statement best describes your experience with iPads?” Figure 5 depicts that 24.44% (n = 22) responded to never using an iPad previous to the study. 23.33% (n = 21) participants self-reported to use an iPad daily.
Figure 5. Participants’ descriptions of previous experience with iPads.

Figure 6 depicts the responses to the question “Does someone in your house own an iPad?” 65.56% ($n = 59$) of participants answered yes to the question.

Figure 6. Participants’ self-report of having an iPad in their house.
Participants that reported using an iPad at least once prior to the study participation were asked to report how they had used the iPad; 75.56% (n = 68) of participants in the entire study reported using an iPad at least once, therefore, the total participants that reported on this particular question was 68. Table 11 shows 91.18% (n = 62) of participants self-reported to have previously played fun games on the iPad and 39.71% (n = 27) of participants self-reported to have read a book previously on an iPad. Some of the other activities reported by participants included Instagram, using a calculator application, and teaching others how to use it.

Table 11

<table>
<thead>
<tr>
<th>Possible Selections to Answer Question 3</th>
<th>Participants who Reported Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Reading a book</td>
<td>27</td>
</tr>
<tr>
<td>Playing Fun Games</td>
<td>62</td>
</tr>
<tr>
<td>Playing Learning Games</td>
<td>34</td>
</tr>
<tr>
<td>Making Art/ Drawing</td>
<td>31</td>
</tr>
<tr>
<td>Getting on the Internet</td>
<td>26</td>
</tr>
<tr>
<td>Taking Pictures</td>
<td>33</td>
</tr>
<tr>
<td>Talking or Texting with Friends</td>
<td>21</td>
</tr>
<tr>
<td>Watching Movies</td>
<td>42</td>
</tr>
<tr>
<td>Listening to Music</td>
<td>38</td>
</tr>
<tr>
<td>Other Activity</td>
<td>7</td>
</tr>
</tbody>
</table>

During the small group phase of the iPad study, after participants read the text *Vegetables* and completed the Posttest, participants were asked four questions about their attitudes related to iPads: (a) How do you feel about reading on the iPad?, (b) Would you want to read more books
on the iPad in school?, (c) Which reading experience is more fun?, (d) How do you feel about reading on an iPad?

All participants in the study \((n = 90)\) answered the questions. The frequencies and percentages are reported in Table 12. Most participants \((n = 79)\) reported liking the experience of reading on an iPad better than reading a regular paper book. Overall, participants were in favor of reading more books on iPads in school \((95.56\% \ (n = 88))\) of participants reported that reading on an iPad was more fun than reading a paper book, and \(90.00\% \ (n = 81)\) of participants reported that reading on an iPad was easier than reading a paper book.

Table 12

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
<th>A (n (%))</th>
<th>B (n (%))</th>
<th>C (n (%))</th>
<th>D (n (%))</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do you feel about reading on the iPad?</td>
<td>I like it better than reading a regular book.</td>
<td>79 (87.78)</td>
<td>3 (3.33)</td>
<td>5 (5.56)</td>
<td>3 (3.33)</td>
</tr>
<tr>
<td>Would you want to read more books on the iPad in school?</td>
<td>Yes</td>
<td>86 (95.56)</td>
<td>2 (2.22)</td>
<td>2 (2.22)</td>
<td></td>
</tr>
<tr>
<td>Which reading experience is more fun?</td>
<td>Reading on an iPad</td>
<td>88 (97.78)</td>
<td>0</td>
<td>3 (2.22)</td>
<td></td>
</tr>
<tr>
<td>How do you feel about reading on an iPad?</td>
<td>It’s easier to read on an iPad than read a paper book.</td>
<td>81 (90.00)</td>
<td>3 (3.33)</td>
<td>5 (5.56)</td>
<td>1 (1.11)</td>
</tr>
</tbody>
</table>
Chapter 5

This study investigated possible impacts of embedded considerate video clips within an expository digital text on the reading comprehension of second and third grade elementary school students at different reading abilities. Through a pretest posttest quasi-experimental design, each student read a digital text on an iPad. This chapter presents major findings from the three hypotheses. Assimilation of findings with previous research findings, practical applications, limitations, and suggestions for future research are also discussed.

Major Findings

Research Question 1.0. The first research question in the current study explored the question: Do participants in the treatment group (VwV) and control group (VwoV) score similarly on preintervention reading characteristics? This question examined group differences at the pretest phase of the study by comparing standardized reading performance scores and topic prior knowledge between groups. While there were no significant differences between groups for participant grade or gender, there was a significant difference in Reading Ability between the groups. The treatment group had more High Ability and Mid Ability readers; the control group had significantly more Low Ability readers. This was a concern and a methodological limitation within the study.

The participants in the treatment and control groups had similar reading ability in four assessed characteristics: (a) QRI-5 Total Concept Questions, (b) QRI-5 Prediction Score, (c) Pretest Question Score, and (d) QRI-5 Total Comprehension Question Score. The first three of these variables relate to a participant’s prior knowledge of content and the ability to predict content within a text based on prior knowledge. The fourth variable measures the overall ability to comprehend a text for literal and inferential meaning.
Differences did emerge in preintervention reading ability between groups. The participants in the treatment group had significantly better reading ability for five standardized reading characteristics compared to participants in the control group: (a) QRI-5 Word List Score, (b) QRI-5 Total Accuracy Miscues, (c) QRI-5 Total Acceptability Miscues, (d) QRI-5 Retell, and (e) QRI-5 Time. The first three of these variables relate to decoding skills in both isolation and in context. The QRI-5 Word List Score measured how many words participants were able to decode in a list. The words were not in any context, and participants did not have to know the meaning of the word; participants only had to say the written aloud. The QRI-5 Total Accuracy Miscues measured the words within the passage that participants deleted, substituted, inserted, and self-corrected; meaning was not considered for this measure, and thus it was strictly based on the decoding of words within a passage. The QRI-5 Total Acceptability Miscues measured the words miscued within the passage that changed the meaning of the passage. The QRI-5 Total Acceptability Miscues account for both decoding and comprehension. “Because the reader is comprehending during the reading process, he or she is able to note a miscue that distorts the author’s meaning” (Leslie & Caldwell, 2011, p. 68). Since all three of these measures incorporate decoding, statistically, the participants in the treatment group were stronger in their ability to decode words both in isolation and in context, compared to the control group.

The participants in the treatment group were also able to recall more details after reading a text as measured in the QRI-5 Retell measure. Participants in the treatment group also needed less time reading the QRI-5 passage than the control group; this was captured in the QRI-5 Time measure.

The QRI-5 Acceptability Miscues Score, which was significantly different between groups, and QRI-5 Total Comprehension Question Score, which was not significantly different
between groups, were used to determine the Reading Ability variable. The treatment group read the QRI-5 passage with significantly less miscues, indicating the participants in the treatment group were more accurate decoders. While the QRI-5 Total Comprehension Question Scores between groups were similar, only participants that had less than 5% acceptability miscues (high decoding ability) and greater than 50% correct on the QRI-5 comprehension questions (high comprehending ability) were categorized as High Reading Ability (see Figure 2). The Reading Ability was significantly different between groups because 76.10% \((n = 35)\) of the treatment group made less than 5% acceptability miscues on the QRI-5 passage compared to 56.80% \((n = 25)\) of the control group. Participants that read with more than 5% acceptability miscues were not High Reading Ability regardless of their comprehension due to the guidelines for Reading Ability. The higher ability to decode in the treatment group influenced the significant difference in Reading Ability between groups discussed above. In this categorization, there is a negative relationship between Reading Ability and Acceptability Miscues.

**Research Question 2.0.** The second research question in the current study explored the question: Do embedded considerate video clips and Reading Ability impact reading comprehension as measured by a posttest? Participants with High Reading Ability and Middle Reading Ability as determined by the QRI-5 answered more posttest questions correctly compared to the Low Reading Ability participants regardless of the treatment. This finding indicates that the ability to decode and comprehend the words within a text significantly impacts digital reading comprehension of texts with and without embedded considerate video clips.

The mean score of the Vegetables Posttest was higher for each of the three Reading Ability groups in the treatment group compared to the control group, but the differences were not statistically significant.
**Research Question 3.0.** The third research question in the current study explored the question: Will the variable set of reading ability, prior knowledge of reading content, and reading a digital text with or without embedded considerate video clips predict to digital reading comprehension in early elementary children? Participants with a higher reading ability and greater prior knowledge about vegetables significantly answered significantly more questions correctly on the posttest; group membership was not an individually significant variable in this model. However, when combined with reading ability and prior knowledge, reading a text with embedded videos contributed to the overall comprehension of a text.

A participant’s Reading Ability was determined by decoding and comprehension measures (QRI-5 Acceptability Miscues and QRI-5 Total Comprehension Question Score). Students who demonstrate a higher reading ability and prior knowledge about the text topic have more success with overall comprehension of a digital text. This finding indicates that reading ability and prior knowledge support digital text comprehension, similar to previous research findings around traditional text comprehension which will be discussed in the following section. The embedded considerate multimedia in the current study neither aided nor harmed the comprehension of readers. Digital text comprehension does not necessarily contradict traditional text comprehension research; instead, research around digital text comprehension can build upon the current traditional text comprehension research.

**Assimilation with Previous Research**

The current research conclusions support the Dual Code Theory (Sadoski & Paivio, 1997). The textual elements as well as the reader elements both contributed to reading comprehension in a statistically significant manner. The theoretical basis for the current study aligned with previous research conclusions discussed in Chapter 2 and will be revisited below.
Reading a text with embedded videos contributed to the overall comprehension of a text when combined with reading ability and prior knowledge. The embedded video clips were textual nonverbal elements with auditory components. The author-created text, Vegetables, with embedded video clips purposely incorporated Mayer’s (2001) seven design principles for authors to considerately use multimedia: (a) Multimedia Principle: combine visual and verbal presentations rather than present information using one mode; (b) Spatial Continuity Principle: present visual and verbal information in close proximity on a page or within a presentation; (c) Temporal Contiguity Principle: present visual and corresponding verbal information simultaneously, rather than sequentially; (d) Coherence Principle: restrict presentation to relevant information; (e) Modality Principle: oral narration, rather than written narration, should be presented with animations; (f) Redundancy Principle: do not provide oral and written narration with animations; and (g) Individual Differences Principle: reader elements influence comprehension. Research incorporating Mayer’s design principles had been previously conducted with university students, but the current study shows that these seven design principles supported young readers in their reading comprehension also.

The current research conclusions also support the findings that reader elements contribute to comprehension in a digital text. The Reading Ability variable in the current study was determined in part by the decoding ability measured by the miscues in the QRI-5 passage (see Figure 2). The ability to decode is a reader verbal element; it is the ability to translate the written alphabetic symbols to oral language. Previous researchers have concluded that the ability to decode is a strong predictor of reading comprehension (Baker & Beall, 2009; Gough, 1984; LaBerge & Samuels, 1974; Rosenblatt, 1978; Stanovich, Nathan, & Vala-Rossi, 1986; Zinar, 2000).
Prior knowledge of a topic tested through the pretest also was a statistically significant contributing factor to the posttest comprehension in the current study. Prior knowledge is a reader nonverbal element and helps the reader build connections and construct stronger bonds with the text (Vygotsky, 1978). Coiro (2007) proposed that prior knowledge of a topic may not be as important when reading digital expository texts; however, the difference between findings may be related to an online network hypertext structure with various complementary digital resources and the structured closed circuit text used in the current study.

The qualitative data collected in the current study supports the previous conclusions that digital texts are motivating for young readers and generally positive attitudes are related to technology (Blok et. al, 2002; Cassady & Smith, 2005; Greenlee-Moore & Smith, 1994). A majority of the participants in the current study reported positive feelings related to reading on an iPad compared to reading a traditional book and desired to read more books on iPads in school. These findings support that using an iPad is engaging and enjoyable (Culen, & Gasparini, 2011; Jennings, Anderson, Dorset, & Mitchell, 2011). The findings support that elementary students like reading on an iPad more than reading a traditional book, want to read more books on iPads in school, and think reading on an iPad is more fun and easier than reading traditional books. These positive attitudes were in both the treatment and control group; they were not contingent upon reading a digital text with embedded videos. These findings indicate that the positive attitudes are more about the device than the text necessarily. The decline of positive attitudes towards reading from first to sixth grade (Reinking & Watkins, 2000) could be countered with the positive attitudes towards reading digital texts on iPads. These positive attitudes towards reading digital texts could also influence students’ motivation, desire, and engagement in reading.
The touch screen was also not difficult for any participant in the study; therefore, the current research supports the intuitive nature and easy hand-eye coordination (Siegenthaler et al., 2012). The qualitative observations in the current study of participants interacting with the iPad also support previous research with university students and adults reporting that interaction with an iPad is easy (Dhir, Gahwaji, & Nyman, 2013; Hutchson, Beschorner, & Schmidt-Crawford, 2012; MacLean et al., 2011; Ostasewski, Reid, & Ostasewski, 2010). These findings suggest that introducing digital texts on iPads into a school setting would not require a lot of instructional time spent on manipulating the text or learning how to interact with the digital text. The transition to reading digital texts on an iPad would not be disruptive for most students.

The current research study aligns with many of the findings of previous studies related to elements contributing to reading comprehension with traditional texts as well as studies exploring digital texts with older participants. The current findings can be used to influence practical applications in the elementary education field in classrooms and schools.

**Practical Applications**

The findings of the current research study should influence instructional practices and fiscal decisions in schools and classrooms. The practical applications described can contribute to the successful preparation of students for interacting with the digital technology in colleges and the workplace. These practical applications may also decrease the current discrepancy between time spent reading digital texts in school and out of school.

1. *Provide more digital texts in schools for students.* Young students have positive feelings about digital texts. The participants in the current study want more digital books in the classroom and believe that reading on an iPad is easier than reading a digital text.

Positive feelings towards any task contribute to motivation and effort. Readers must have
the will to read in order to be successful (Miller & Faircloth, 2009). Stakeholders making fiscal decisions should invest in digital texts for students.

2. **Support instruction on decoding and comprehension.** A student’s reading ability is determined by their ability to decode and comprehend a text. A student with a middle or high reading ability is able to better comprehend digital texts with and without embedded multimedia compared to a student with a low reading ability. Explicit, systematic word recognition instruction teaches readers how to transform the written word into oral language (Adams, 1990). Additionally, strong comprehension of one text often translates to strong comprehension of a similar text (Miller, 2002; Vacca et al., 2006).

3. **Build prior topic knowledge of content before reading texts.** Prior knowledge of the content contributed to predicting the reading comprehension of a nonfiction digital text in the current study. Teachers can activate schema and build students’ prior knowledge of a topic through field trips, virtual tours, reading texts on the same topic to build a thematic unit, and class discussions (Miller, 2002; Vacca et al., 2006).

**Limitations**

There were several limitations related to the methodology of the current study that may impact generalizability. Due to the nature and daily objectives of a school building, many of these limitations were not within the researcher’s control.

First, the study was conducted during the school day within a school building. Participants completed all pretests individually with the researcher in a vacant classroom or a private room in the back of the library. All components of the small group phase were also completed in the vacant classroom. The classroom door remained closed, but it was on a busy hallway within the school, and typical noises from classes transitioning were noted.
Occasionally, an announcement was also made on the school-wide speaker system, which may have been distracting to study participants.

The randomization of the treatment or control group was stratified based on the homeroom classes. Scheduling small groups of eight to ten students to be pulled from typical classroom instruction for about 45 minutes was least disruptive to the typical day if all students in the same class were pulled at the same time or in two distinct times. Therefore, all students in one teacher’s class were either in the treatment or control group. In a true experimental design study, individual students would have randomly been assigned to the treatment or control group. The limitation of the current study is that teacher factors, such as experience or ability to teach traditional reading comprehension strategies, may have impacted reading comprehension data of students. Descriptive data on teachers and teaching ability was outside of the scope of the current study and was not considered.

The pretest-treatment interaction is another methodological limitation. The pretest and the posttest questions were the same questions, but in a different order. It is possible that exposure to the questions during the pretest phase of the study could impact the posttest comprehension data.

**Future Research**

The data analysis and methodology of the current study has implications for future research in the field of digital reading comprehension. Currently, studies investigating the implications of touch screen technology for educational purposes are scarce, but as touch screens continue to increase in the public market and in school buildings, the number of studies should increase, and the field will expand to investigate various aspects. Below are some suggestions for future research based on the current study.
The current study recruited participants that participate daily in a general education literacy classroom focused on grade-level appropriate curriculum. Participants with an individual education plan that participated in the general education literacy curriculum were not identified for the purposes of this study. Several studies have investigated the impact of touch screens with special education students in a self-contained classroom with various tasks, but few, if any, have investigated the effects of embedded considerate multimedia features on digital reading comprehension with special education students.

The current study used a nonfiction digital text with and without embedded considerate multimedia. The focus on nonfiction texts aligns with the demands of the Common Core Standards, but fiction texts are necessary for a balanced literacy program. Future research should explore the impact of considerate multimedia embedded within fictional texts on digital reading comprehension.

Only considerate multimedia video clips were embedded in the digital text in the current study and compared with a control group reading a digital text without any images. Previous studies have compared digital texts with paper texts, but future studies should explore the effects of embedded dynamic images (Mayer, 2008) with static digital images on the reading comprehension of young children. There may also be a threshold for embedded images that may support or distract from digital reading comprehension that can be explored.

There are many ways in which reading comprehension can be probed. The current study used eight multiple-choice recall questions to capture reading comprehension after reading. Open response questions and retell activities as well as more complex tasks such as producing a product also have been used to measure reading comprehension. Recording and analyzing participants’ comments through a think-aloud protocol while reading a digital text may also yield
important understandings. Future research may choose a different way of probing digital reading comprehension in order to expand this field.

Finally, the qualitative data in the current study provided a deeper understanding of the participants, but future research should explore the qualitative implications at a deeper level. For example, participants did not display any unacceptable behaviors during the current study. It is outside of the scope of the current study to compare time on task while using an iPad and time on task while reading a traditional paper text or during a typical classroom lesson. Teacher and parent surveys regarding young children’s ability to focus on a digital reading task is an area that would have implications for future classroom management and engagement.

A deeper analysis of the qualitative data collected in the current study was also beyond the scope of the current research questions. Previous experience with iPads may have impacted interaction with the digital text or attitudes towards iPads. Similarly, the qualitative data may be explored for differences between participants in the treatment or control group. There were no additional probes for the attitude questions in the current study. Asking students with negative or indifferent attitudes towards iPads follow-up questions may yield strategies to adjust and differentiate technology in the classroom to support all learners positively.

The presence of digital technology and touch screens are increasing in the public market. School districts and stakeholders will have to make choices to continue to purchase traditional texts or invest in digital texts. While research related to digital reading comprehension in young children is in its infancy, it is a worthwhile field to continue to probe and investigate through future studies.
References


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Educational Psychology, 93, 243-250.


Appendix A

QRI-5 Level Two Protocol

Word List:
1. morning
2. tired
3. shiny
4. old
5. trade
6. promise
7. pieces
8. suit
9. push
10. though
11. begins
12. food
13. light
14. visit
15. clue
16. breathe
17. insects
18. weather
19. noticed
20. money

Concept Questions:
What do flowers need to grow?
What does “forest animals in the winter” mean to you?
What does “changing seasons” mean to you?
Seasons

There are four seasons in a year. They are spring, summer, fall, and winter. Each season lasts about three months. Spring is the season when new life begins. The weather becomes warmer. Warm weather, rain, and light make plants grow. Some plants that looked dead during the winter grow again. Tulips are plants that come up every spring.

Summer begins on June 20th for people who live in the United States. June 20th is the longest day of the year for us. We have more sunlight that day than on any other day. Insects come out in summer. One bug that comes out in summer likes to bite. The bite hurts and it itches. Do you know what that bug is? It’s the deerfly.

Summer ends and fall begins during September. In fall we continue to get less light from the sun. In the North, leaves begin to die. When they die they turn brown. Then they fall off. Nuts fall from trees. They are saved by squirrels to eat in the winter.

Winter begins just a few days before Christmas. December 21st is the shortest day of the year for us. We have less light that day than on any other day. In winter many animals have to live on food that they stored during the fall. There are no green plants for the animals to eat. Winter ends when spring begins on March 20th. The seasons keep changing. Plant life begins and ends each year. (247 words)

Questions for Seasons
1. How long does each season usually last?
2. What are the conditions needed for flowers to come up in the spring?
3. Which day has more sunlight than any other?
4. According to your reading, what insect’s bite makes you itch?
5. How do you know that fall is coming even if the weather is warm?
6. Why do leaves die in the fall even when the weather is warm?
7. About when in September does fall begin?
8. Why do squirrels save nuts for eating in winter?
Appendix B

Vegetables

There are many foods that we eat. Some are healthy and some are not. Fruits and vegetables are good to eat. They help to make your body big and strong. Most fruits and vegetables grow outside. Warm weather, rain, and light help the food grow. The food can grow underground, on plants, or on trees. Some food grows on farms and some grows in gardens.

Radishes, carrots, and beets are vegetables that grow underground. The part we eat grows in the dirt and leaves grow above. We dig out these vegetables and throw away the top. These vegetables are healthy. Radishes, carrots, and beets are called root vegetables. Radishes are red and round. Carrots are orange and long. Beets can be purple.

Broccoli, lettuce, and celery are also vegetables. These foods grow above the ground. We do not eat their roots. Broccoli looks like little trees. Lettuce has many leaves. Celery grows in stalks. Broccoli, lettuce, and celery are all green foods.

Corn is a food that also grows outside in fields. Corn grows in the middle of a tall stalk. We do not eat the bottom or top of a corn stalk. We throw away the bottom and top and eat the corn in the middle. Corn can have yellow or white kernels. Some corn has yellow and white kernels together. Corn is a starchy vegetable. All of these foods grow each year.
Appendix C

Vegetables without Videos

1. Practice Book
   - There was a girl. The girl did not know how to dance. Then she learned to dance.

2. What did the girl learn to do?
   - A. Sleep
   - B. Dance
   - C. Eat
   - D. Run

3. Vegetables
   - There are many foods that we eat. Some are healthy and some are not. Fruits and vegetables are plant parts we eat. They help to make your body big and strong.

4. Most fruits and vegetables grow outside. Sun, rain, air and food help plants grow. Fruits and vegetables can grow underground, on plants, or on trees. Some food grows on farms, and some grows in gardens.

5. Radishes, carrots, and beets are vegetables that grow underground. The part we eat grows in the dirt and leaves grow above. We dig out these vegetables and throw away the top. These vegetables are healthy.

6. Radishes, carrots, and beets are called root vegetables. Radishes are red and round. Carrots are orange and long. Beets can be purple.

7. Broccoli, lettuce, and celery are also vegetables. These foods grow above the ground.

8. Broccoli looks like little trees. Lettuce has many leaves. Celery grows in stalks. We do not eat their roots. Broccoli, lettuce, and celery are all green foods.

9. Corn is a food that also grows outside in fields. Corn grows in the middle of a tall stalk. We do not eat the bottom or top of a corn stalk. Corn grows on a cob in a husk.
Corn on the cob is made up of many small kernels. A kernel has starch inside. The starch gives people energy. All of these foods grow each year.

| 13 | STOP |
| 14 | **What types of food are healthy?** |
| 15 | A. Fruits and vegetables  
| 16 | B. Chocolate and French fries  
| 17 | C. Bread and candy  
| 18 | D. Juice and noodles  
| 19 | **What do plants need to grow?** |
| 20 | A. Sun, air, food, rain  
| 21 | B. Air, food, sun, nuts  
| 22 | C. Rain, darkness, air, food  
| 23 | D. Darkness, air, rain, nuts  
| 24 | **Where do beets grow?**  
| 25 | A. On a tree  
| 26 | B. Underground  
| 27 | C. On a bush  
| 28 | D. Above ground  
| 29 | **What type of vegetable is a carrot?**  
| 30 | A. Tuber vegetable  
| 31 | B. Squash vegetable  
| 32 | C. Root vegetable  
| 33 | D. Seed vegetable  
| 34 | **Where does broccoli grow?**  
| 35 | A. On a tree  
| 36 | B. Underground  
| 37 | C. On a bush  
| 38 | D. Above ground  
| 39 | **What part of lettuce is not eaten?**  
| 40 | A. The head  
| 41 | B. The leaves  
| 42 | C. The roots  
| 43 | D. The top  
| 44 | **Where does corn on the cob grow?**  
| 45 | A. In a root case  
| 46 | B. Underground  
| 47 | C. On a bush  
| 48 | D. In a husk  
| 49 | **What is inside a corn kernel?**  
| 50 | A. Popcorn  
| 51 | B. Starch  
| 52 | C. Oil  
| 53 | D. Roots  
| 54 | **How do you feel about reading on the iPad?**  
| 55 | A. I like it better than reading a regular book  
| 56 | B. I like it less than reading a regular book  
| 57 | C. I like it the same as reading a regular book  
| 58 | D. I don't know  

Good job! You are finished with questions about the book! Share about your reading experience...
<table>
<thead>
<tr>
<th>Would you want to read more books on the iPad in school?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Yes</td>
</tr>
<tr>
<td>B. No</td>
</tr>
<tr>
<td>C. I don't know</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
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<tr>
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</tr>
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<td>C. I don't know</td>
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</tbody>
</table>

<table>
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<tbody>
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</tr>
<tr>
<td>B. It is harder to read on an iPad than read a paper book</td>
</tr>
<tr>
<td>C. Reading on an iPad and a paper book are the same difficulty</td>
</tr>
<tr>
<td>D. I don't know</td>
</tr>
</tbody>
</table>
Appendix D

Vegetables with Videos

1. Practice Book

2. There was a girl. The girl did not know how to dance. Then she learned to dance.

3. What did the girl learn to do?
   A. Sleep
   B. Dance
   C. Eat
   D. Run

4. Fruits and Vegetables

5. There are many foods that we eat. Some are healthy and some are not. Fruits and vegetables are plant parts we eat. They help to make your body big and strong.

6. Most fruits and vegetables grow outside. Sun, rain, air and food help plants grow. Fruits and vegetables can grow underground, on plants, or on trees. Some food grows on farms, and some grows in gardens.

7. Radishes, carrots, and beets are vegetables that grow underground. The part we eat grows in the dirt and leaves grow above. We dig out these vegetables and throw away the top. These vegetables are healthy.

8. Corn is a food that also grows outside in fields. Corn grows in the middle of a tall stalk. We do not eat the bottom or top of a corn stalk. Corn grows on a cob in a husk.

9. Radishes, carrots, and beets are called root vegetables. Radishes are red and round. Carrots are orange and long. Beets can be purple.

10. Broccoli, lettuce, and celery are also vegetables. These foods grow above the ground.

11. Broccoli looks like little trees. Lettuce has many leaves. Celery grows in stalks. We do not eat their roots. Broccoli, lettuce, and celery are all green foods.
<table>
<thead>
<tr>
<th>Page</th>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
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</tr>
</tbody>
</table>
Title: The Effects of Embedded Considerate Multimedia Features on Digital Text Comprehension Among Second and Third Grade Students at Different Reading Abilities

Principal Investigator: Dr. Jonathan Eakle, Ph.D.; Associate Research Professor in the School of Education

Student Researcher: Lindsay Sullivan; Doctoral Student in the School of Education

Date: December 19, 2013

PURPOSE OF RESEARCH STUDY:
- The purpose of this research study is to identify effects, if any, of video clips embedded in a digital book on a child’s reading comprehension. We anticipate that approximately 150 children will participate in this study.

PROCEDURES:
- Your child will be asked to read a second grade passage aloud to a researcher. Your child will then retell the passage and answer comprehension questions related to the passage and concept questions unrelated to the passage to the best of their ability. Your child will also be asked about any previous experiences they have had with an iPad. This session will be one-on-one with the researcher and is expected to take about 15-20 minutes.
- In a small group setting of six to eight students, your child will be asked to read a book on an iPad. Students will be taught how to operate the iPad before reading the book. After reading, your child will be asked eight multiple-choice comprehension questions and how reading on the iPad compares to reading a paper book. This session is expected to take about 30 minutes.

RISKS/DISCOMFORTS:
- Your child may miss up to 60 minutes of regular classroom instruction.
- The risks associated with participation in this study are no greater than those encountered in daily life.
BENEFITS:

- Your child will learn about weather and how vegetables grow. These topics are directly related to fourth quarter school curriculum and will provide your child with background knowledge for classroom instruction that will take place later in the school year.

- This study may benefit society if the results lead to a better understanding of digital text comprehension.

VOLUNTARY PARTICIPATION AND RIGHT TO WITHDRAW:

- Your child’s participation in this study is entirely voluntary: You choose whether to allow your child to participate, and we will also ask your child whether he or she agrees to take part in the study. If you decide not to allow your child to participate, or your child chooses not to participate, there are no penalties, and neither you nor your child will lose any benefits to which you would otherwise be entitled.

- If you and your child choose to participate in the study, you or your child can stop participation at any time, without any penalty or loss of benefits. If you want to withdraw your child from the study, or your child wants to stop participating, please submit a written request to withdraw from the study to your child’s classroom teacher.

CONFIDENTIALITY:

- Any study records that identify you or your child will be kept confidential to the extent possible by law. The records from your child’s participation may be reviewed by people responsible for making sure that research is done properly, including members of the Johns Hopkins University Homewood Institutional Review Board and officials from government agencies such as the National Institutes of Health and the Office for Human Research Protections. (All of these people are required to keep your identity and the identity of your child confidential.) Otherwise, records that identify you or your child will be available only to people working on the study, unless you give permission for other people to see the records.

- In order to ensure confidentiality, a code number rather than your child’s name will be shown on data sheets.

COMPENSATION:

- If your child satisfactorily completes the study, he or she will receive a grade appropriate book for participating. Books will be given at the end of the study.

- Your child will be entered in a raffle for a class pizza party during lunch at the conclusion of the study.

IF YOU HAVE QUESTIONS OR CONCERNS:

- You and your child can ask questions about this research study now or at any time during the study, by talking to the researcher working with your child or by calling Lindsay Sullivan at 443-509-4254.
• If you or your child have questions about your child’s rights as a research participant or feel that your child has not been treated fairly, please call the Homewood Institutional Review Board at Johns Hopkins University at 410-516-6580.

SIGNATURES

WHAT YOUR SIGNATURE MEANS:

Your signature below means that you understand the information in this consent form. Your signature also means that you agree to allow your child to participate in the study.

By signing this consent form, you have not waived any legal rights your child otherwise would have as a participant in a research study.

__________________________________________
Child’s Name

__________________________________________
Signature of Parent                      Date

__________________________________________
Signature of Legal Guardian (if applicable)    Date

__________________________________________
Signature of Person Obtaining Consent        Date
(Investigator or HIRB-Approved Designee)
Appendix F
Verbal Assent

Johns Hopkins University
Homewood Institutional Review Board (HIRB)

Assent Form

<table>
<thead>
<tr>
<th>Title:</th>
<th>The Effects of Embedded Considerate Multimedia Features on Digital Text Comprehension Among Second and Third Grade Students at Different Reading Abilities</th>
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<td>Student Researcher:</td>
<td>Lindsay Sullivan; Doctoral Student in the School of Education</td>
</tr>
<tr>
<td>Date:</td>
<td>December 19, 2013</td>
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</tbody>
</table>

We want to tell you about a research study we are doing. A research study is a way to learn more about something. We would like to find out more about reading a book on an iPad. You are being asked to join the study because you are in second or third grade.

If you agree to join this study, you will be asked to read a passage to a researcher and answer questions about it. You will also be asked if you have ever used an iPad before. In a second visit, you will be in a small group of students from your class and you will be taught how to read a book on an iPad. You will read a book on an iPad and answer questions about it.

If you choose to enter into the study, you will get a free book. You will also be entered to win a class pizza party.

We expect that the study will help you by reading about weather and vegetables to help you prepare for books you will be reading with your teacher in the classroom during the fourth quarter. This study will help us learn more about how students read books on iPads.

You do not have to join this study. It is up to you. You can say okay now and change your mind later. All you have to do is tell us you want to stop. No one will be mad at you if you don’t want to be in the study or if you join the study and change your mind later and stop.

Before you say yes or no to being in this study, we will answer any questions you have. If you join the study, you can ask questions at any time. Just tell the researcher that you have a question.
Appendix G

Pretest

Where does corn on the cob grow?
   A. In a root case  
   B. Underground     
   C. On a bush       
   D. In a husk

Where does broccoli grow?
   A. On a tree      
   B. Underground    
   C. On a bush      
   D. Above ground

Where do beets grow?
   A. On a tree      
   B. Underground    
   C. On a bush      
   D. Above ground

What types of foods are healthy?
   A. Fruits and Vegetables
   B. Chocolate and French Fries
   C. Bread and Candy
   D. Juice and Noodles

What part of lettuce is not eaten?
   A. The head       
   B. The leaves     
   C. The roots      
   D. The top

What do plants need to grow?
   A. Sun, air, food, rain       
   B. Air, food, sun, nuts       
   C. Rain, darkness, air, food  
   D. Darkness, air, rain, nuts

What is inside a corn kernel?
   A. Popcorn         
   B. Starch         
   C. Oil            
   D. Roots

What type of vegetable is a carrot?
   A. Tuber vegetable  
   B. Squash vegetable
   C. Root vegetable  
   D. Seed vegetable
Appendix H
Self-Report of Ipad Experiences

Which statement best describes your experience with iPads?

0. I have never used an iPad before.
1. I have used an iPad 1-3 times before.
2. I have used an iPad 4-10 times before.
3. I use an iPad outside of school every week.
4. I use an iPad outside of school every day.

Does someone in your house own an iPad? Yes or No

If you have used an iPad before, what have you used it for? Circle all that apply

- Reading a book
- Playing fun games
- Playing learning games
- Making Art/Drawing Pictures
- Getting on the Internet
- Taking pictures
- Talking or texting friends
- Watching Movies
- Listening to Music
- Other (explain): _____________
Appendix I

Ipad Small Group Mini-Lesson

Objective: Students will be able to operate a digital text on iPad tablet by turning a digital text page, viewing an embedded video, and selecting a multiple-choice answer.

Materials: This lesson will use a four page practice digital text (see Figure 1).

Figure 1. Screenshots of digital text practice book pages.

Introduction: (All italicized font is instructor script). Boys and girls, today you are going to read a book on an iPad. Before you read the book, however, I would like to show you how you will turn the pages, watch a video, and choose an answer to a multiple-choice question. You will need to do these three things in order to read the book on the iPad. Before I show you how to use the iPad, though, let’s look at the iPad rules. Read the iPad rules on the class chart paper.

Model: Have all students in the small group sit in a semi-circle so they are able to see the researcher’s iPad.

When you get the iPad, you will push the button at the bottom to turn it on. Show students where the button is located and push it.

You will then use your finger to unlock the iPad by swiping across the bottom. Model for students how to swipe and unlock the iPad.

Your iPad may need a passcode. The passcode is 0064. It is written on the board. Model for students how to enter the passcode.

After you unlock your iPad, you will see Vegetables 1 (or 2) title on your iPad.

The first page will have music notes and say “Let’s Practice (or Let’s Practice 2).” You will turn the page by swiping your finger to the left. I only need to use one finger and the page will turn. Model for students how to turn the page.

Before you begin, you will need to put on the headphones. If you need the volume turned up or down, raise your hand, and I will help you.
On some pages, there will be words and a picture at the top with a triangle in a circle in the middle of the picture. You will need to read the words at the bottom of the page using your very best reading. After reading, you will touch the triangle in the circle to watch a short video. Watch the entire video before moving on. Watch as I do it. Model for students how to touch the play icon to watch the video.

When the video is over, I can turn the page. Model turning the page again. After you read the book, there will be a stop sign page. You will stop at the stop sign page until everyone is finished reading the book. When I tell you to, you will be able to turn the page to the question pages. The questions are all about the book, so read the book carefully. I will read the question to you and the four possible answers. You will need to listen very carefully to the answers because only one answer is correct. When you decide which answer you think is correct, you will use your finger to “tap-tap” on the answer you choose. Then, use the little circles to highlight the entire answer. Tap on the “highlight” word and choose your color. Watch me as I do it. Model for students how to choose and highlight one correct answer.

Practice: Now I am going to give an iPad and you will practice turning a page, watching a video, and choosing one answer. If you need help, raise your hand, and I will help you.

Assess: As students use the practice book, I will check that they are able to do the three things independently. The researcher will use a checklist to indicate competency (see Table 1).

Table 1

Checklist to assess student ability to operate a digital text

<table>
<thead>
<tr>
<th>Participant Code</th>
<th>iPad</th>
<th>Ability to turn a digital page</th>
<th>Ability to access an embedded video</th>
<th>Ability to select one answer</th>
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</thead>
<tbody>
<tr>
<td>Example Student 1</td>
<td>iPad #</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

Now you are ready to begin reading the text. Since this is your time to read on your own, I can’t give you any hints or any help. If you come to a word you don’t know, do your best and keep on going. Do you understand so far? When you are done reading, stop at the stop sign. When everyone is ready, you’ll answer some questions about the text. Does anyone have any questions?

Ready? The text is called “Vegetables.”

*Time students/make anecdotal notes

After Comp. Questions:

These next questions are about how you feel about reading on an iPad.
Conclusion:

You all did a fantastic job! Thank you very much for all your hard work. I hope you enjoyed being a part of the iPad study. I'm going to give you an index card and a pen. Write your name on the card. Listen carefully as I call your iPad number. When I call your number, put your iPad on the post-it. Then, put your card in the bucket. I will choose a card in two weeks for a student to win a pizza party for his or her entire class. Then, pick up a book. The book is for you to take home and keep. You will then line up at the door. Are there any questions?
<table>
<thead>
<tr>
<th>Time began reading</th>
<th>Notes</th>
<th>Video embedded?</th>
<th>Audio?</th>
<th>Colorblind access embed</th>
<th>Text embedded?</th>
<th>Entry to lesson</th>
<th>Time began lesson</th>
<th>Group</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
Appendix K

Posttest

What types of foods are healthy?
A. Fruits and Vegetables
B. Chocolate and French Fries
C. Bread and Candy
D. Juice and Noodles

What do plants need to grow?
A. Sun, air, food, rain
B. Air, food, sun, nuts
C. Rain, darkness, air, food
D. Darkness, air, rain, nuts

Where do beets grow?
A. On a tree
B. Underground
C. On a bush
D. Above ground

What type of vegetable is a carrot?
A. Tuber vegetable
B. Squash vegetable
C. Root vegetable
D. Seed vegetable

Where does broccoli grow?
A. On a tree
B. Underground
C. On a bush
D. Above ground

What part of lettuce is not eaten?
A. The head
B. The leaves
C. The roots
D. The top

Where does corn on the cob grow?
A. In a root case
B. Underground
C. On a bush
D. In a husk

What is inside a corn kernel?
A. Popcorn
B. Starch
C. Oil
D. Roots
Appendix L

Self-Report of Ipad Experience

How do you feel about reading on the iPad?

A. I like it better than reading a regular book.
B. I like it less than reading a regular book.
C. I like it the same as reading a regular book.
D. I don’t know

Would you want to read more books on the iPad in school?

A. Yes
B. No
C. I don’t know

Which reading experience is more fun?

A. Reading on an iPad
B. Reading a paper book
C. I don’t know

How do you feel about reading on an iPad?

A. It’s easier to read on an iPad than read a paper book.
B. It’s harder to read on an iPad than read a paper book.
C. Reading on an iPad and paper book are the same difficulty.
D. I don’t know
Appendix M

Multiple Regression Power Analysis

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Power</th>
<th>N</th>
<th>R</th>
<th>Alpha</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>.99</td>
<td>150</td>
<td>.60</td>
<td>.05</td>
</tr>
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</table>

*Note. Adapted from [http://www.statstodo.com/SSizMReg_Pgm.php](http://www.statstodo.com/SSizMReg_Pgm.php)*
Curriculum Vitae

Education
Doctorate in Education, January 2010 – May 2015
Teacher Development and Leadership
Focus in Reading Development
Johns Hopkins University, Baltimore, Maryland
NCATE Accredited Program

Administrator I Certificate
Towson University, Baltimore, Maryland
NCATE Accredited Program

Masters of Science in Education, July 2008
Concentration in Reading
Reading Specialist Certification
Johns Hopkins University, Baltimore, Maryland
NCATE Accredited Program

Honors Degree
Bachelor of Science in Elementary Education, May 2004
Minor: Spanish Studies
University of Delaware, Newark, Delaware
NCATE Accredited Program

Study Abroad: Granada, Spain
Fall Semester 2002
La Universidad de Granada

Certification
Received Administrator I Certificate
Successfully completed GRE.
Successfully completed PRAXIS I and PRAXIS II.
Received Achievement of Excellence Award for PRAXIS II.
Highly Qualified by federal government standards.

Teaching Experience
Elementary Literacy Coordinator
Baltimore City Public Schools, Baltimore, Maryland
Support literacy curriculum and assessments for grades 1-5. Develop and coordinate professional development in pedagogy and content for elementary literacy teachers, literacy coaches, and school administrators. Collaborate with nonprofit organizations and vendors in supporting elementary literacy components. Coordinate work of nine Literacy Academic Content Liaisons. (Spring 2015-Current)
**Literacy Academic Content Liaison**  
*Baltimore City Public Schools, Baltimore, Maryland*

Support 14 Kindergarten through fifth grade elementary schools in Network two around literacy planning and implementation. Attend collaborative planning meetings for grade level teams at schools to analyze STEP and Amplify data and plan upcoming lessons. Support principals with schoolwide literacy plans. Develop and present content sessions at monthly literacy representative meetings. Present district initiatives at monthly principal and instructional leadership team meetings. Develop, train facilitators, and present systemic professional development for district teachers. (Summer 2012-Spring 2015)

**Adjunct Faculty**  
*Johns Hopkins University, Baltimore, Maryland*

Develops syllabus and implements lessons based on standards and objectives for *Materials for Teaching Reading* course and the *Diagnosis and Assessment for Reading* course. Most students are first and second year teachers obtaining graduate education degrees through Teach for America and Baltimore City Teaching Residency programs. Lessons integrate lectures and small group collaboration. (Spring 2009-Summer 2012)

**First Grade Teacher**  
*Dundalk Elementary School, Baltimore County School District, Baltimore, Maryland*

Develops and implements differentiated lessons for a heterogeneous class including special education students. The Title I school educates a majority of low-income students. Teaches inclusion class and works very closely with a special educator in the classroom. Attends weekly IEP meetings. Daily implements the Open Court phonics curriculum and the Houghton Mifflin comprehension curriculum including the Houghton Mifflin English Curriculum, Comprehension Toolkit, and Reading Research Lab. The whole-to-part model is executed for the reading block. Scott Foresman-Addison Wesley Math curriculum integrated with *Investigations* 2008 guides the five E lesson format for math instruction. Active member of the first grade team and school-wide reading committee. Helps to implement school-wide reading incentive program and reading night. (August 2004-July 2012)

**Personal Data**

Date of Birth: July 9, 1982

Place of Birth: Baltimore, Maryland

Married: Sean Sullivan

Children: Claire and Eve Sullivan