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THE EFFECTS OF TARGETED ENGLISH LANGUAGE ARTS INSTRUCTION USING MULTIMEDIA APPLICATIONS ON GRADE THREE STUDENTS' READING COMPREHENSION, ATTITUDE TOWARD COMPUTERS, AND ATTITUDE TOWARD SCHOOL

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Abstract

The purpose of this study was to investigate the specific effects of targeted English Language Arts (ELA) instruction using multimedia applications. Student reading comprehension, student attitude toward computers, and student attitude toward school were measured in this study. The study also examined the perceptions, of selected students, of the use of these applications. In this study, targeted ELA instruction was compared to similar instruction of ELA skills with the addition of multimedia software applications.

In this study a sampling of grade 3 students in a medium-sized suburban school district received 10 weeks of targeted ELA instruction using traditional teaching methods. From this sample, approximately half of the students received instruction with ELA multimedia applications in lieu of a portion of the allotted ELA instruction time

Two instruments were administered to all students as a pretest and as a posttest; the New York State English Language Arts Exam Part 1 (NYS ELA) and the Young Children's Computer Inventory (YCCI). In addition, five students were selected for a semi-structured interview. The interviews explored the perceptions of the students who used the ELA

multimedia applications in school and showed the greatest gain in reading comprehension scores at the conclusion of the treatment period.

A pretest ANOVA was used to verify equivalency of groups for reach variable. Following this, a MANOVA revealed that students who participated in the treatment group and received ELA instruction using online multimedia applications scored significantly higher than students in the control group. Univariate ANOVA revealed that students in the treatment group scored higher on the attitude toward computers measure and the reading comprehension measure, and that there was no significant difference in scores on the attitude toward school measure between treatment and control groups.

Analysis of the qualitative data revealed three themes that recurred throughout the five interviews. The themes were: having fun, learning content, and expressing emotions. Qualitative and quantitative data were triangulated, and implications for practitioners and researchers were discussed.

APPROVAL PAGE

School of Professional Studies
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Doctor of Education in Instructional Leadership

Doctor of Education Dissertation

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Acknowledgements

I had been considering the idea of obtaining a doctoral degree for a few years before I actually applied to WCSU and began doing the work to make it happen. Having now completed the dissertation, I am so glad to have embarked on this journey. It is like no other challenge that I have taken on, and has been truly fulfilling and rewarding in a way that probably only those who have completed the process can really understand. The process of working on this study has been transformative for me as a learner and as a professional, and a big part of that comes from the people who helped me get through it and went through it with me.

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Lastly, to my wife Elise, although it was all so "easy," you made it more so. Your support, encouragement and genuine interest in this whole long, strange trip have been so important to me, and I am blessed to have you as my life partner.

Dedication

This dissertation is dedicated to my grandparents Esther and Sam. Like all good Jewish grandparents, they always wanted their children and grandchildren to be doctors. I am so happy to finally oblige them. This may not be exactly what they had in mind, but better late than never! I miss you both and wish you could be here for this.

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CHAPTER ONE: INTRODUCTION TO THE STUDY

The use of computers in K-12 classrooms has grown exponentially over the past decade, as has the use of multimedia and online instructional tools. Students between 8-18 years of age spend almost 8 hours a day using multimedia content (Kaiser Family Foundation, 2010). Almost 69% of all teens own a personal computer and 75% of all teens own smart phones (Pew Internet Project, 2009). Educators typically receive many hours of professional development in the use of multimedia and online instructional tools, and schools have invested millions of dollars in the hardware and infrastructure required to enable the use of multimedia content. Professional development occurs with the laudable goals of improving academic achievement, but progress in attaining that goal is often not measured.

Multimedia content can offer an engaging and exciting delivery method for academic content. It is appealing to children, and modern software allows for progress monitoring and self-paced learning. Much effort has been put into developing these applications, and schools are wisely seeking new and cost effective ways to extend the school day, differentiate instruction, meet the needs of a diverse population, and cope with growing class size. Research indicated that the type of software used with children could have a significant effect on learning. Specifically, software that provides feedback to students, is rich in multimedia content, and provides for student self-direction, is necessary to improve learning (Bialo & Sivin-Kachala, 1996). These characteristics are descriptors of various types of multimedia software in use in our schools today.

Mayer explains meaningful learning as a deep understanding of new material that is integrated with prior knowledge (Mayer & Moreno, 1998a). In this study the concept of meaningful learning is applied to the goal of improving reading comprehension through the

use of multimedia applications. Meaningful learning, in this context, is the process of building upon and increasing reading comprehension. Mayer's Cognitive Theory of Multimedia Learning (CTML: Mayer, 2002) suggests that individuals learn through both a visual and a verbal processing system, that these systems are discrete, and that the integration of both systems produces better results than using only one system. English Language Arts (ELA) multimedia applications can be an effective tool in teaching reading comprehension, along with traditional instruction (Mayer, 2001), and reading comprehension is a key factor in academic success (Henderson & Buskist, 2011).

This study explored the effectiveness of multimedia applications with elementary school students and how the use of these applications affected reading comprehension, attitude towards computers, and attitude towards school. In addition, the perceptions of students were explored in the qualitative portion of the study.

Rationale for Selecting the Topic

The researcher has spent over a two decades supporting teachers in the use of instructional technology tools in their classrooms. Over the years there have been many opportunities to implement new programs and initiatives, including numerous projects involving instructional applications. Having deployed many of these applications, the question was often posed about the efficacy of these initiatives. There is little research that addresses this topic, and much of what does exist is vendor sponsored. In particular, trustees, parents, and administrators want to understand the return on investment for these initiatives, in terms of academic achievement and other related factors. This study examined the use of one specific application, Destination Reading (2007) on the reading comprehension, attitude toward computers, and attitude toward school of grade 3 students in one specific school

district. Reading comprehension is a key target of many federal and state education efforts, as well as many local school district educational initiatives. Reading comprehension is a core academic skill that affects all others and is essential for academic success (National Reading Panel, 2003). Attitude toward school may affect student achievement (Marks, 1998). As such it is worth exploring factors that affect attitude positively or negatively.

Statement of the Problem

School districts are under increasing pressure to deploy the latest technology tools to students and staff. Increasingly, schools are purchasing instructional software applications to solve the problems of crowded classrooms, limited instructional time, and declining budgets. These programs are often driven by vendor claims of efficacy, parental pressure on school district leaders, and the desire of school boards to remain competitive with neighboring districts. In addition, it is assumed that instructional software allows teachers to differentiate instruction, have students work in small groups, and allows for students to pace their progress independently. There is a need for a better understanding of how instructional software applications affect student learning and attitude. All too often school administrators deploy the latest technology tools based on scant evidence or biased manufacturer's claims. It is the obligation of school leaders to understand the research before implementing costly and time consuming technology initiatives that profoundly impact our schools.

Potential Benefits of the Research

This research provided valuable data to administrators in the host district on the efficacy of their current practices. The district had invested heavily in the use of instructional software applications in reading, math, science, social studies, and engineering. District leadership was considering further investments in the areas of English Language Learning

(ELL), credit recovery, and technology literacy. However, the leadership in this district had not formally assessed the efficacy of these initiatives. This research assessed the specific area of ELA, however the data gleaned here and the research methodologies used might be applicable to other subject areas given the similarity of the format and delivery method of the various multimedia applications.

The research results may be of benefit to other districts considering investing in instructional software applications. This study was designed to be generalizable to similar suburban districts and provide useful information for administrators and teachers in other districts.

Finally, student use of computers can increase student engagement and improve student attitude toward school (Sandholtz, Ringstaff, & Dwyer, 1997). This study provided information on the effect of computer use on student attitude among grade 3 students.

Definition of Key Terms

The following terms will be used throughout this research study:

1. **Attitude toward computers** is a measure of the individual's feelings about the importance of computer use and enjoyment using computers (Knezek, Christensen, Miyashita, & Ropp, 2000). Attitude towards computers was measured by the Young Children's Computer Inventory (YCCI) instrument (Miyashita & Knezek, 1992).
2. **Attitude toward school** is a measure of the value or significance that the student attaches to the idea of school. Attitude towards school, when positive, is a protective measure that supports learning and success in school (Jessor, Van Den

Bos, Vanderryn, Costa & Turbi, 1995). This construct was also measured by the YCCI instrument (Knezek, 1992).

3. **ELA** refers to the area of English Language Arts (New York State Testing Program, 2009). This acronym is commonly used in New York State to refer to the subject area as well as the state exam. It includes instruction in reading comprehension, writing skills, listening, grammar, and phonics.
4. **Multimedia** is the combination of different modes of content delivery in a single application. Multimedia usually includes audio, video, text, images, animation, narration, and other interactive content on web pages. Multimedia is used with the understanding that the brain processes verbal and visual information separately and that by using a multimedia approach there will be a greater cognitive impact (Mayer, 2002).
5. **Reading comprehension** is defined as the ability of the reader to construct meaning from the written word. It is described as a complex and active process whereby the reader uses strategies to derive meaning from text (National Reading Panel, 2003). In the context of this study it was taught as a discrete skill by the grade 3 teachers as well as by the software used in the treatment, and it was measured by the NYS ELA exam.

Research Questions and Hypotheses

This study explored two specific questions, as below:

1. Is there a significant difference in the reading comprehension, attitude toward computers, and attitude toward school of students who receive targeted ELA instruction using multimedia applications and those who receive targeted ELA

instruction without multimedia applications?

Directional Hypothesis: Students who receive targeted ELA instruction using multimedia applications will score significantly higher on reading comprehension scores, significantly higher on measures of attitude toward computers and attitude toward school, than those who receive targeted ELA instruction without multimedia applications.

2. What are the perceptions of students who use multimedia applications in school and show the greatest gain in reading comprehension after the study treatment period?

Summary

To address these questions, approximately half of the grade 3 students in a medium-sized suburban school district received 10 weeks of targeted ELA instruction using traditional teaching methods. The other half of the students received instruction with ELA multimedia applications for a portion of the time spent using traditional teaching methods. The ELA multimedia instruction was delivered in the student's regular classroom and in school computer labs using a multimedia application, Destination Reading (2007).

Two instruments were administered to all students who participated in the study. The NYS ELA Exam (New York State Testing Program, 2009) measured reading comprehension, and the YCCI (Knezek, 1992) measured attitude toward computers and attitude toward school. In addition, 5 students were selected for a semi-structured interview. The interviews explored the perceptions of the students who used the ELA multimedia applications in school and showed the greatest gain in reading comprehension on the ELA exam at the end of the treatment period. This was measured by comparing the pretest and the

posttest scores of all students in the treatment group and determining which five students showed the greatest net gain.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

The literature relevant to this research is discussed in four sections. As a contextual background, the researcher examined the overall impact of Computer Aided Instruction (CAI) in schools. The overall efficacy of CAI was examined in various studies across a wide sampling of content areas and grade levels. The Cognitive Theory of Multimedia Learning (CTML: Mayer, 2002) provided the theoretical foundation for this research. The CTML was examined with a regard to understanding how multimedia instruction works, how the brain processes multimedia instruction, and how to design the most effective multimedia learning situation. Finally, attitude toward computers and attitude toward school (Knezek et al., 2000) were examined within the relevant literature in relation to the impact these constructs had on student learning. An examination of the overall effect of computer use on attitude toward school as well as the effect of computer use on attitude toward computers took place in this study.

While there was much literature available to support the theoretical underpinning of this study and the variables measured, there was a dearth of research targeting this specific grade level of students and the specific treatment implemented. In particular, while there was research available on ELA applications in elementary schools, much of it was not for third grade. Similarly, research on the Cognitive Theory of Multimedia Learning tended to involve older students. Only the attitude constructs had a large amount research pertaining to the primary grades, including grade 3. This gap was a justification for the present research in that this study addressed a particular combination of variables, students, and treatment not addressed by previous researchers.

Impact of Computer Aided Instruction in Schools

This review of the literature began with several meta-analyses, narrowed in focus to specific studies of CAI and then further narrowed to examine the use of CAI to improve reading comprehension as a discreet skill that can be taught using computers in the school setting.

The use of computer aided instruction has shown positive growth in reading achievement and reading comprehension (Soe & Chang, 2000). A meta-analysis conducted by Soe and Chang (2000) reviewed 17 studies completed between 1982 and 1998. All of the studies included the use of CAI as an independent variable and reading comprehension or reading achievement as a dependent variable, and were implemented in grades K-12. A majority of the studies (88%) used standardized measures of achievement, and 65% took place over a period of 5-12 months. In all, 41% of the studies were published after 1994, and most students (66%) were ethnic minorities, educationally challenged, or economically disadvantaged. Sample sizes ranged from a low of 20 to a high of 558 students per study. Statistical analyses were completed on the sample data. The researchers combined effect sizes for the 17 studies to determine a composite effect size of 0.1316, which was significant at the .05 level when calculated with a critical value of 1.96. A scatter plot analysis of the studies was used to determine if the variables of sample size, duration of treatment, and grade level of students had an effect on individual effect size. Finally, an analysis of study tolerance was completed. No systematic variation was found that was related to these variables. The authors found that they would have needed to consider an additional 893 new studies that showed no effect of CAI in order to change the outcome of this study. The study was deemed highly tolerant. The researchers concluded that there is reason to believe that

CAI can have a positive impact on reading achievement in the K-12 setting. However, due to the large variability of the studies analyzed, they did not propose a standard protocol for delivery of this instruction.

A second meta-analysis conducted in Turkey (Camnalbur & Erdogan, 2008) evaluated the effect size of studies which took place between 1998 and 2007. The authors sought to determine if CAI was more effective than traditional, teacher-centered methods. The original pool of studies was 422. This was reduced to 78 studies based on specific selection criteria, including date of original study, minimum sample size, publication status, duration of treatment, and research design. Total sample size for the combined treatment group was 2,536 and for the control group 2,560. The meta-analysis was carried out using the study effect technique to calculate a *Cohen's d* value from research that had results determined using differing scales. The *d* value calculated from each study was used as a basis of comparison for the larger meta-analysis. Using the fixed effects model, Camnalbur and Erdogan (2008) determined an effect size of 0.95, large, and indicated that academic achievement was higher for students receiving CAI. The *z* test calculation was completed and significance was determined ($z = 31.81$, $p < .01$). The authors suggested that CAI is indeed an effective method of instructional delivery and did have a significant effect on learning when compared to traditional methods.

The third meta-analysis examined was conducted by Kulik and Kulik (1991). These researchers conducted an extensive meta-analysis of 254 studies on CAI to determine the effect of such instruction on academic achievement and attitude toward teachers and computers. They also examined the amount of time required to deliver instructional content using the traditional, teacher-directed method vs. computer based instruction. Criteria for

inclusion in the study were that each study had to have taken place in real classrooms and had to have involved delivery of genuine content, had to have provided quantitative data, and had to have included acceptable research designs. Analysis of the selected studies revealed that in 81% of the cases, students receiving CAI (treatment) had significantly higher academic scores on posttests than those in traditional classrooms (control). In addition, average effect size was 0.30, indicating that the typical student in the computer based instruction class would score higher than 62% of the students in the traditional classroom. Nineteen of the included studies also examined student attitudes. Kulik and Kulik (1991) reported that in 15 of these 19 studies students showed positive attitudinal changes, with an effect size of 0.34. Regarding time required to deliver instruction, students in the CAI groups required only 70% of the instructional time to gain the same effect as students in the control group. It was noted that length of treatment had an inverse affect on effect size. Specifically, shorter treatments (four weeks or less) had greater effect sizes than longer treatments of one month or more. Kulik and Kulik speculated that a combination of factors were determinant. The Hawthorne effect may have been a factor, along with contamination of the control group over longer treatment periods. However no conclusive rationale for this relationship was offered. Overall, CAI classes produced significantly higher academic and attitudinal scores as compared to traditional classes.

These three meta-analyses offered a broad overview of the field of CAI. It is clear that the effect of CAI was positive in the majority of cases, in terms of both academic achievement and attitude. In addition, the studies reviewed covered a variety of cultures, student ethnicities, school settings, student socioeconomic backgrounds, and grade levels. It is worth noting that not all researchers point to the benefits of CAI. Cuban (2010) has stated

his desire to see a moratorium on new computer purchases for schools until instruction changes dramatically from a teacher-centered instructional model to a student-centered instructional model that can capitalize on the technology already in place. He is one of a growing group of critics of the efficacy of CAI in general. The following paragraphs addressed specific individual studies targeting the effect of CAI on reading comprehension.

Two studies conducted by Macaruso and Rodman (2011) showed that preschoolers and kindergarteners who received computer aided instruction using a multimedia early literacy application showed significant gains in phonological awareness, word reading, and basic phonics skills when compared to a control group. The protocol of both of these studies was similar to the research project described in this dissertation. In the first study, Macaruso and Rodman (2011) used preschool half-day classrooms. In this study teachers had separate morning and afternoon classes that were randomly assigned as treatment or control groups. Students in the treatment group used the Lexia Learning Early Reading Program (Lexia Reading) for a period of 200 minutes over 4 months, 3 times a week for 10-15 minutes per session. The control students received access to other computer programs that did not address literacy for the same time block. Initial sample size was 41 treatment students and 38 control students, with no significant difference in age between groups. Once the use threshold of 200 minutes was calculated, a number of students in each group were eliminated from the study because they did not meet the 200 minutes of minimum required usage. The final sample size was 19 treatment and 19 control students. Students were from diverse ethnic and socioeconomic backgrounds in both groups. Students were pretested and posttested using the Group Reading Assessment and Diagnostic Evaluation (GRADE) instrument. This instrument included four subscales which were added to form a composite

score as per the instrument author. Alternate forms of the GRADE were used for pretest and posttest administrations. Teachers received instruction in the software from the researchers and then implemented it on their own schedule during the four months of the study. In a one-sample t-test analysis, the treatment group showed gains on the GRADE, $t(18) = 3.19$, $p = .01$, while the control group showed no gain, $t(18) = -.011$, $p = .91$. An effect size of 0.69, moderate, was determined from the mean posttest scores of the two groups.

The second study by Macaruso and Rodman (2011) reported similar results. In this study kindergarten students were pretested using the GRADE instrument and low-performing students were identified (those scoring below 85 on the instrument). From this group, the students were randomly assigned to treatment and control groups. In total, 47 treatment students received 600 minutes of instruction over a 7-month period. The control group consisted of 19 students who received no computer aided literacy instruction. As in the present research study, students were trained in the software and progressed at their own pace through the program. Students who did not log at least 600 minutes of use were excluded from the study. Total test scores on the GRADE were analyzed and no significant difference was found on mean pretest scores. Mean posttest scores increased for both groups. The scores for the treatment group were significantly higher than the control group, $t(64) = 2.08$, $p = .05$, medium to large. Similarly to the pre-school study, the authors concluded that the use of CAI in this study led to significant gains in early literacy acquisition for the low performing kindergarten students.

Many other studies have examined the effect of a technology-rich classroom on academic achievement. Butzin (2001) compared traditional classrooms in the Miami-Dade County Schools in Florida. The district deployed technology-rich classrooms that took part

in Project CHILD (Computers Helping Instruction and Learning Development,) an effort by the district to enhance instruction using technology, including multimedia applications. This study compared a traditional teacher-centered instructional delivery model with a transformed learning environment that included advanced technology tools and hands-on learning stations. Butzin (2001) compared preliminary scores on the Stanford Achievement Test (SAT-5) of second and fifth grade students in the traditional and transformed learning environments, and conducted *t*-test analysis to verify that the groups were equivalent prior to the study. The SAT-5 used 3 subscales to measure the constructs reading comprehension, mathematics computation, and mathematics application. Equivalence was verified and group demographics were matched to ensure a similar population in both groups. Analysis revealed that SAT-5 scores for the Project CHILD students at the end of the year were significantly higher in mathematics application in grade 2, reading comprehension in grade 5, mathematics computation in grade 5, and mathematics application in grade 5 when compared to students in the traditional classrooms. Butzin concluded that the effects of Project CHILD were positive, as seen by the higher scores in all three SAT-5 subscales after three years in the program (grade 5 students) as opposed to those who have been in the program for only one year (grade 2 students) when compared to the control group of traditional classrooms. However, reading comprehension scores did not improve for grade 2 treatment students, and this discrepancy was not explained by the author.

Wild (2009) examined the impact of CAI on the acquisition of phonological skills by Year 1 (age 5-6) students randomly selected from 6 schools in the United Kingdom. The researcher worked with 127 students from 7 classrooms over a period of 10-12 weeks. Within each class, students were randomly assigned to 1 of 3 groups (treatment, control, or

comparison). The treatment group (n = 44) received phonological instruction using the Rhyme and Analogy computer program for 2 days each week during the treatment period. The control group (n = 40) received teacher-directed instruction for a matching time duration on a math program. The comparison group (n = 43) received the similar amount of time receiving phonological instruction from the teacher without the use of any software or computers (paper worksheets). All three groups were pretested using the Phonological Assessment Battery (PhAB) and the Marie Clay Dictation Test, and scores were analyzed using an ANOVA. The data analysis showed no significant differences in pretest scores between the three groups, $F(2,126) = 0.19$, $p > .05$. All three groups were well balanced in terms of gender, special education status, and native language status of students. The researcher went to great lengths to ensure that students in all three groups had the same duration of instruction, and that the treatment and comparison groups received the same content through different means (paper based and computer based). The treatment consisted of delivering the content of six books from one unit of instruction, either using a paper based or computer based methodology. The computer based program included CD-ROM's that provided feedback and interaction for students on the content covered. The software was adaptive in that it increased difficulty level with student success and reduced difficulty level with student failure. Verbal and visual feedback and cues were provided by the software as well for success and failure. Both treatment and comparison groups received a single 20 minutes session per week in isolation from the regular class, either as a paper based lesson or on the computer. The control group received 20 minutes of isolated math instruction per week that did not require reading or writing. ANOVA analysis showed significant between-groups effects based on overall scores from the PhAB measure $F(2,126) = 13.336$, $p < .01$.

Gains were shown for all groups but those using the CAI program were most significant. Gains for the control and comparison groups were similar to each other and well below those of the treatment group, and were not significant when compared to the treatment group. These results indicated that in this study, paper based reading instruction was as effective as no reading instruction in increasing achievement. The author concluded that the data indicated that the use of CAI can have a significant positive effect on achievement when compared to traditional teacher-centered instruction or no instruction.

The above meta-analysis and individual studies show that CAI can have a significant effect on academic achievement. CAI offered the promise of delivering instruction in a shorter time with greater academic gain. These studies highlighted the potential for using CAI to customize instruction to meet the needs of individual learners, deliver differentiated and self-paced instruction, and to manage diverse learners efficiently. In the following section, the theoretical foundation of multimedia software use, the Cognitive Theory of Multimedia Learning, was examined, as well as how this theory drove an understanding of learning with multimedia, how it helped to develop multimedia applications, and how multimedia use affected learning at a cognitive level.

Cognitive Theory of Multimedia Learning

Multimedia learning is the delivery of instruction using two modalities concurrently (Mayer, 2002). The use of visual learning (pictures, written text, animations, and videos) and verbal learning (spoken narration) as discrete channels for delivering content is different than the traditional classroom practice of lecturing to students or having students read silently. Multimedia learning can be delivered by a teacher, but is often delivered by a computer running a software application.

Essential to the Cognitive Theory of Multimedia Learning (CTML) is the notion that the brain processes information using two discrete channels and two discrete memory paths (Mayer & Moreno, 1998b). According to Mayer and Moreno, the verbal (auditory) channel is responsible for processing music, sound accompanying video, and spoken words. The visual (ocular) channel processes written text, animation, still images, and moving video images. This is an essential part of the CTML and is displayed graphically in Figure 1.

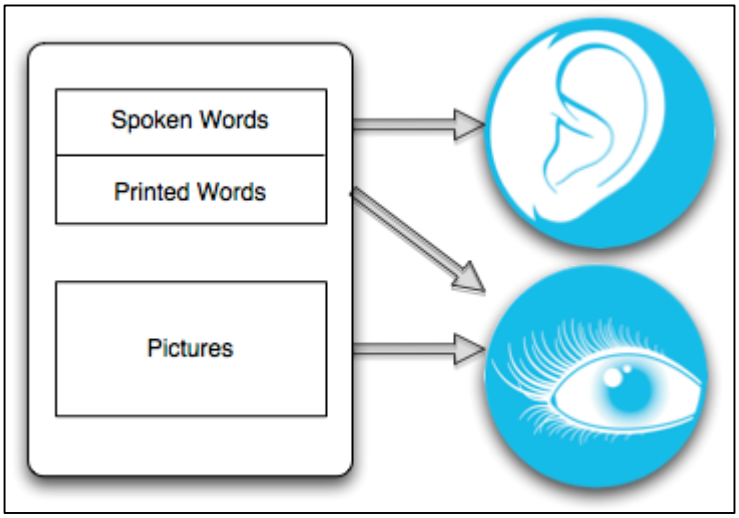

Figure 1. Processing of Information Using the Visual and Verbal Channels. This figure illustrates how words can be assimilated through the ears or the eyes depending on if the words are spoken or printed. Pictures are assimilated through the eyes only. Adapted from O'Connor (2010).

Mayer states that there are a number of principles at work in multimedia learning (Moreno & Mayer, 2000). The Multiple Representation Principle indicates that meaningful learning occurs when both channels (verbal and visual) are used at the same time. This process involves the learner connecting the information from each channel and mentally cross-referencing it in working memory, which improves learning. The Spatial Contiguity Principle states that any text and visual content should be contiguous; that is they should be

close to each other on the page or screen. The Temporal Contiguity Principle states that verbal and visual content should be contiguous in time; both forms of content should be presented together in time rather than asynchronously. Placing both words and pictures explaining the same content into working memory at the same time is beneficial. If this information is out of synch, the mind is less able to connect the information from the two channels. The Split Attention Principle states that when showing visual content it is preferable to present words as verbal content rather than as text on the screen. This method is preferable because the written text is processed visually with the images, while the verbal text is processed through the ears with the verbal processing system (Mayer, 2002). The Modality Principle states that students learn better when text is presented in verbal form (as narration) rather than in visual form (as written text). Mayer suggests that this is due to the fact that when processing visual images and written text, the learner is using the same channel, resulting in cognitive overload. However, if the learner processes the same visual images with verbal text (narration), he or she is using two distinct channels and thus better able to process the information. The Redundancy Principle further refines the description of how multimedia learning is most effective. Mayer states that while two channels of content can be more effective, too much content can be counter-productive. In fact, presenting animation and narration and written text is not more effective than animation and narration alone. The final principle outlined is the Coherence Principle. Mayer states that background sounds and music take away from the learner's experience rather than adding to it. These verbal distractions can overload the auditory channel and take away from the ability to process essential auditory content.

Figure 2 provides a detailed overview of the CTML. The figure depicts content presented as words and pictures. Pictures are processed through the sensory memory via the eyes as visual stimulus and are then processed by the brain in working memory. Words can be processed in one of two ways. Spoken words are processed through the sensory memory via the ears as verbal stimulus. Written words are processed through sensory memory via the eyes as visual stimulus. This graphic is a clear example of how educators can customize delivery of instruction to maximize learning by choosing the correct channel for the words.

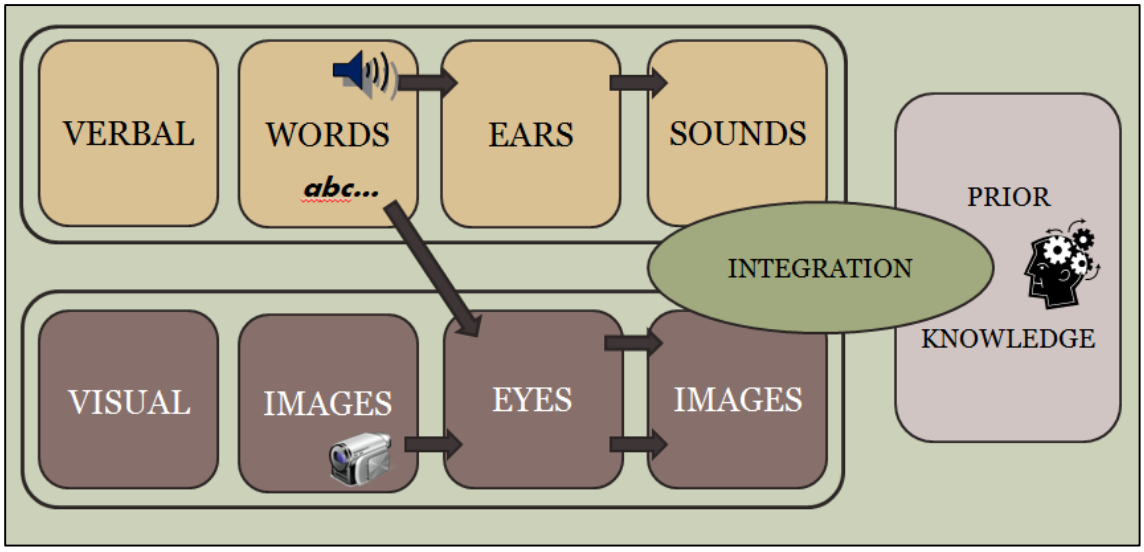

Figure 2. Cognitive Theory of Multimedia Learning This figure is a flowchart depicting how information is processed through both the verbal and visual channels through two memory spaces. Adapted from Jeren, Pale, and Petrovicyer (2012).

Below each principle from the perspective of Mayer's research was examined in greater detail with a look at the specific research supporting each principle.

The Multiple Representation Principle

The Multiple Representation Principle is the foundation of the CTML. It was developed by Mayer to help explain how the brain processes new information and is supported by research from Mayer and others. According to the Multiple Representation

Principle, the brain has two discrete channels for processing information, and when the learner uses both channels the brain is more successful in processing the information (Mayer & Moreno, 2002). The classic example of the Multiple Representation Principle is the presentation of content using animation along with accompanying audio narration. This approach is more successful than either presenting narration alone or animation alone (Mayer & Moreno, 2002). Mayer terms this a multimedia effect. It supports the CTML in that Mayer's work shows that multimedia content is more effective than either verbal or visual content alone. Mayer and Anderson's seminal study (1991) demonstrated the effect of these various modes of instruction on problem solving and content retention of the participants. In this study Mayer randomly assigned 48 college students to 1 of 4 groups. All groups were determined to be equivalent in terms of mechanical aptitude; the content was a mechanical lesson on the structure and function of a bicycle pump. Group one received no instruction on the content. Group two received instruction through words only, group three received instruction through pictures only, and group four received instruction using contiguous words and pictures. As predicted, group four (words and pictures) received significantly higher scores on the problem solving measure (M = .62, SD = .16) than group one (M = .29), group two (M = .28) and group three (M = .39). An ANOVA was conducted and revealed that mean scores for groups one, two, and three were not significantly different, but that mean scores for group four were, $F(3,44) = 58.19$, $p < .00$. Group four outperformed the three other groups on the problem solving measure.

Part two of this experiment measured verbal retention of content presented. Using the same instructional choices, Mayer found that group four (M = .67, SD = .22) and group two (M = .64, SD = .24) outperformed group three (M = .45, SD = .24) and group one (M = .30,

SD = .20) by a significant margin. This would appear to indicate that the words with pictures and the words only group were not significantly different from each other ($p < .05$) but both groups performed better than the control and picture only groups. This initial study led to many additional studies that examined the notion in fuller detail. As seen in Figure 3, the words with pictures groups scored higher than all three other groups on both measures.

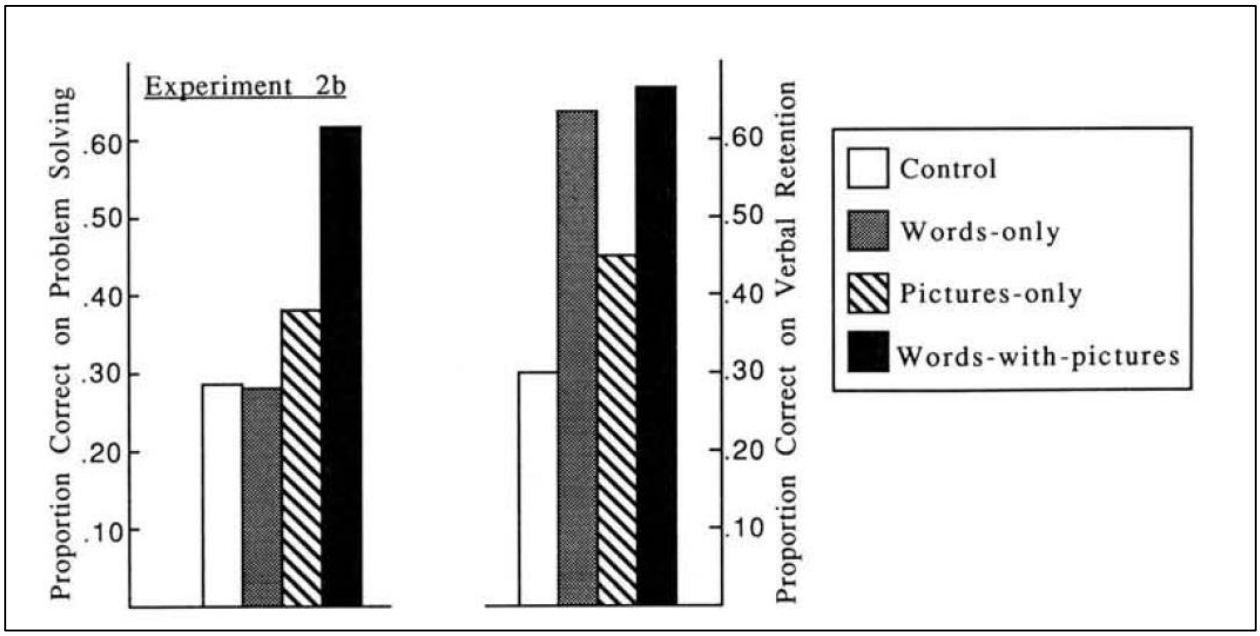

Figure 3. Experimental Results Demonstrating the Multiple Representation Principle The bar graph depicts the results of the multiple representation principal experiment. Adapted from Moreno and Mayer (1999).

The Spatial Contiguity Principle

While it is important to present content in both the verbal and visual modes, it is also important to present text and animation in spatial contiguity (Moreno & Mayer, 1999a). A study of 132 college students was devised to test this theory. Students were randomly assigned to three groups and pretested to ensure equivalency in terms of prior meteorology knowledge. Each group viewed an animation that explained the formation of lighting. One

group viewed an animation with on-screen text embedded in the visual animation (IT group). The second group saw the same animation with on-screen text separated spatially from the animation (ST group). A third group saw an animation and narration concurrently (N group). This last group was included to distinguish between the optimal learning situation (animation and narration) and the text-based learning samples. Figures 4, 5, and 6 show samples of the screen image for each scenario.

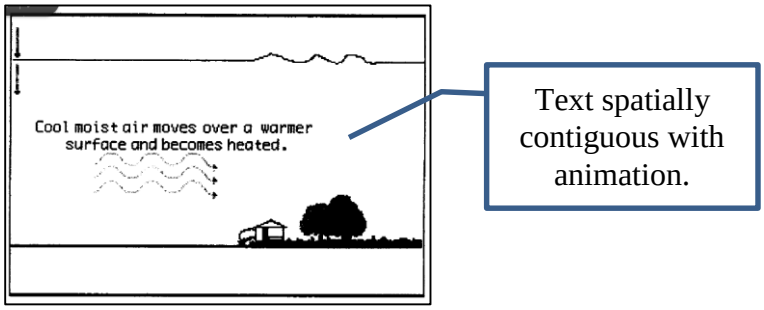

Figure 4. Screen Capture of Instruction for IT Group

Illustration of the screen image shown to the IT group in the spatial contiguity experiment. Adapted from Moreno and Mayer (1999).

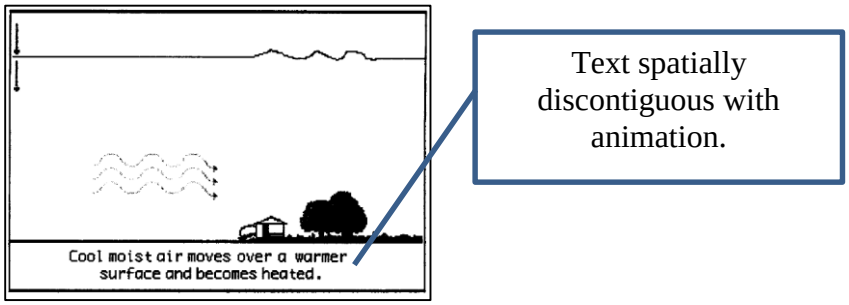

Figure 5. Screen Capture of Instruction for ST Group

Illustration of the screen image shown to the ST group in the spatial contiguity experiment. Adapted from Moreno and Mayer (1999).

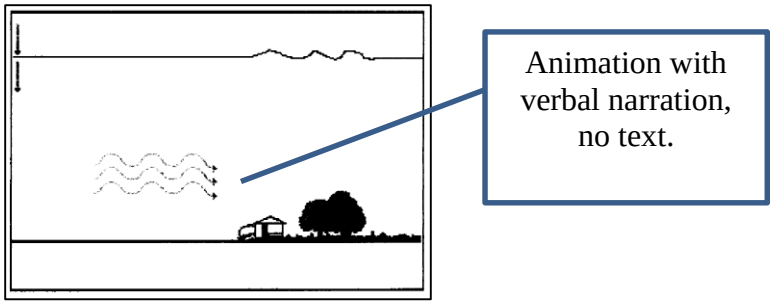

Figure 6. Screen Capture of Instruction for N Group

Illustration of the screen image shown to the N group in the spatial contiguity experiment. Adapted from Moreno and Mayer (1999).

Students were assessed on three variables: verbal recall of the content presented in the treatment, transfer of knowledge to a similar learning simulation, and matching of facts and images from the content presented. Figure 7 displays percentage scores on each variable for each group.

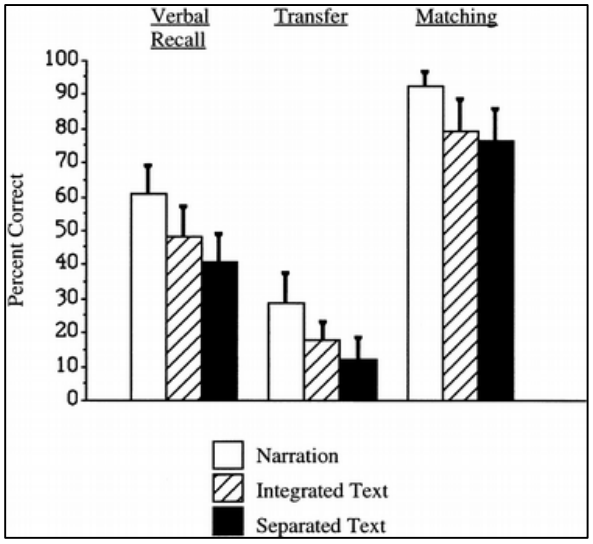

Figure 7. Results of Spatial Contiguity Experiment

This bar graph depicts the results of the spatial contiguity principal experiment. Adapted from Moreno and Mayer (1999).

On the verbal recall test, the N group averaged 61%, the IT group averaged 48% and the ST group averaged 41%. The ANOVA revealed a significant main effect for the treatment group, $F(2, 119) = 16.137$, $MSE = 8.861$, $p < .001$. The N group scored significantly higher than the IT and ST groups, yielding an effect size of 1.00 for narration, and the IT group scored significantly higher than the ST group, with an effect size of 0.47 for spatial contiguity. These results support the Multiple Representation Principle (N groups scored highest) and the Spatial Contiguity Principle (IT group scored higher than ST group).

A similar pattern was seen on the knowledge transfer test. The N, IT and ST groups averaged 38%, 23%, and 16%, respectively. The ANOVA revealed a significant main effect for the type of multimedia used, $F(2, 119) = 24.073$, $MSE = 1.746$, $p < .001$. The N group scored significantly higher than the IT and ST groups, and the IT group scored significantly higher than the ST group. The effect size was 1.06 for modality (N rather than IT and ST) and 0.48 for spatial contiguity (IT compared to ST). Again, these results supported the Multiple Representation Principle (N groups scored highest) and the Spatial Contiguity Principle (IT group scored higher than ST group).

On the matching test, the N group averaged about 93%, whereas the IT group and the ST groups averaged about 80% and 77%, respectively. The ANOVA revealed a significant main effect for the type of multimedia used, $F(2, 119) = 18.632$, $MSE = 8.203$, $p < .001$. The N group scored significantly higher than the IT and ST groups, which did not differ significantly from each other. The effect size was 1.32 for type of multimedia used, (N rather than IT or ST) and 0.17 for spatial contiguity (IT compared to ST). In this case the results support the Multiple Representation Principle (N groups scored highest) but do not

support the Spatial Contiguity Principle (IT group did not score significantly higher than ST group).

The Temporal Contiguity Principle

While the CTML stated that contiguity in space is important, it also stated that time is an essential factor in effective content delivery. Specifically, Mayer, Moreno, Boire, and Vagge (1999) examined how temporal contiguity affects content retention, knowledge transfer, and matching ability with 60 college students. The researchers divided the students into three groups. Group one (content presented in large sections, alternating verbal and visual content), group two (content presented in small sections, alternating verbal and visual content), and group three (content from both verbal and visual modalities presented concurrently according to the Multiple Representation Principle). The researchers found a significant difference between scores on knowledge transfer tests ($p < .001$) between groups 1, 2, and 3. The researchers conclude that when content is presented in large sections, it is better to present the information from each channel contiguously in terms of time. With small pieces of content it is acceptable to alternate between the two modalities with no apparent effect.

The Split Attention Principle

The idea that words can be processed as either verbal or auditory content is unique to the CTML and the split attention principle elaborates on this notion. Mayer and Moreno (1998) examined how 78 college students processed information in a learning simulation. Students were divided into two equivalent groups and presented with two different learning scenarios. The learning simulation was a multimedia presentation explaining how lightning forms and discharges. Both groups had equivalent prior knowledge of this process and

received the same content, but by using two different modalities. One group (AN) received the content with an animation (visual content) and concurrent narration (verbal content). Mayer and Moreno postulated that this group would score higher on three measures due to the fact that they were using both the visual and the verbal memory channels to acquire and process information. The second group (AT) viewed the animation (visual content) with concurrent on-screen text (visual content). Mayer and Moreno postulated that this group would score lower on three measures due to the fact that they were using only the visual memory channel to acquire and process information (1998).

Results of the study validated the researcher's hypothesis. As seen in Figure 8 below, AN students scored higher on the retention measure than did AT students, $F(1, 76) = 15.987$, $MSE = 2.187$, $p < .001$. On the measure of matching images to text, AN students scored higher than AT students, $F(1, 76) = 7.805$, $MSE = 2.380$, $p < .01$. These results were consistent with the predictions of the dual-processing hypothesis. On the measure of knowledge transfer, AN students scored higher than AT students, $F(1, 76) = 44.797$, $MSE = 1.683$, $p < .001$. Effect sizes for each test were substantial: 0.89 for the retention test ($SD = 0.19$), 0.55 for the matching test ($SD = 0.22$), and 1.75 for the knowledge transfer test ($SD = 0.19$).

As per the split attention principle, the group receiving content through two distinct channels (AN) scored significantly higher on all three tested variables following the delivery of content. The group receiving content through only the visual channel (AT) was not able to process as much information in the same channel. Results are displayed in Figure 8.

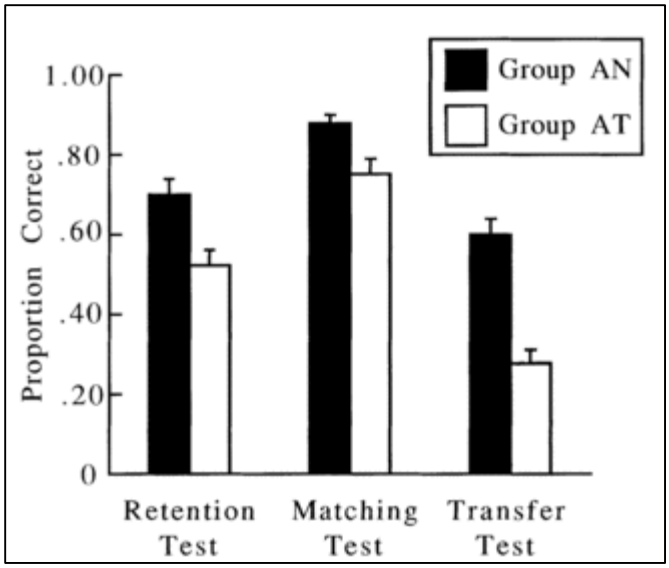

Figure 8. Results of the Split Attention Study

This bar graph depicts the results of the split attention principal experiment. Adapted from Moreno and Mayer (1999).

The implications of this research were profound. According to Mayer and Moreno (1998), multimedia learning must include content in both the visual and the verbal channels to be effective. The brain cannot process as much information in one channel as it can if it is using both the visual and the verbal channels. These two content delivery methods are shown in Figure 9 with three different types of content.

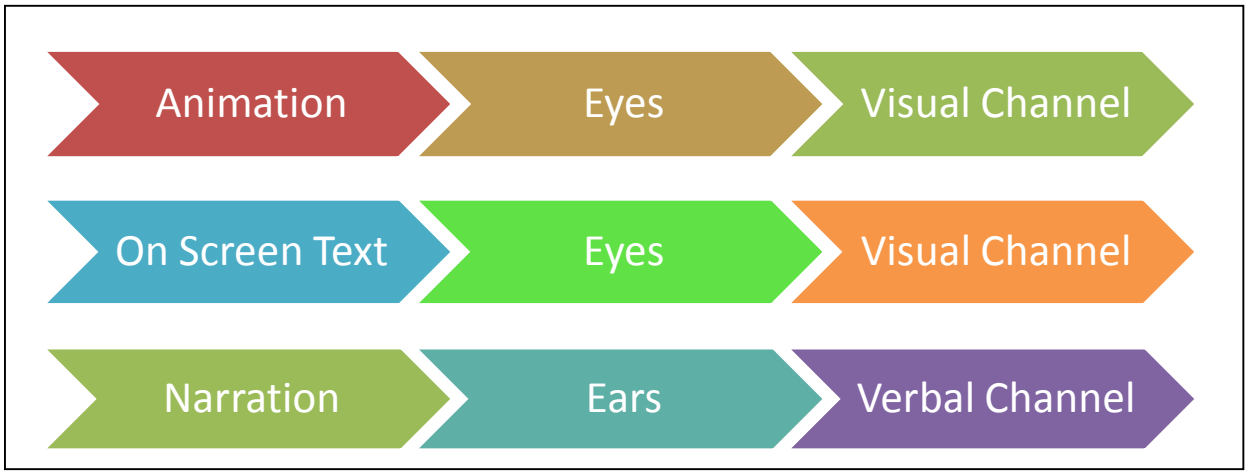

Figure 9. Path of Content Delivery to Working Memory as per the Split Attention Principle This figure depicts how content is processed by different sense organs and different memory channels depending on the mode of delivery.

There is also danger in designing multimedia environments that students will be over-stimulated by too much content (Sorden, 2005). Some researchers proposed that the ability of the brain to process information was limited. Multimedia content should be appealing and attractive, but not overburden the student's cognitive abilities with too much on-screen activity (Sorden, 2005). The notion of presenting content using both channels to ensure maximum effect supported the idea of cognitive overload.

The Modality Principle

Moreno and Mayer (1999) also examined the question of the effectiveness of on-screen text as compared to narration as part of multimedia learning. The modality principle stated that when presenting words along with images it is better to hear the words as a narration than read the words as visual text. This supported the notion of the advantage of presenting content in two distinct channels, as Mayer suggested (Moreno & Mayer, 1999a). Their study of 132 college students attempted to determine which mode of instruction was more effective, written or spoken text along with visual images. Students were separated into

three groups. Group N had 41 members and received instruction via narration and animation with no written Text. Group IT had 41 members and received the instruction with animation and contiguous written text. Group ST had 40 members and received the instruction with animation and non-contiguous written text. Students received instruction in one of these groups. Three separate constructs were measured: verbal recall, transfer of knowledge, and matching images and text. In all three cases the groups receiving instruction via on screen text (IT and ST) scored significantly lower ($p < .001$) than the group receiving instruction via narration when combined with visual content.

On the verbal recall measure, the N group averaged 61%, whereas the IT and the ST groups averaged 48% and 41%, respectively. The ANOVA revealed a significant main effect for the treatment group, $F(2, 119) = 16.137$, $MSE = 8.861$, $p < .001$. The N group scored significantly higher than the IT and ST groups, with an effect size of 1.00 for narration, and the IT group scored significantly higher than the ST group, yielding an effect size of 0.47 for spatial contiguity. These results supported the notion that presenting visual content with verbal narration was more effective than on-screen text, regardless of its contiguity to the image.

On the transfer of knowledge measure, the proportion of correct solutions on the transfer test by students in the N, IT, and ST groups was on average 38%, 23%, and 16%, respectively. The ANOVA revealed a significant main effect for the treatment group, $F(2, 119) = 24.073$, $MSE = 1.746$, $p < .001$. The N group scored significantly higher than the IT and ST groups, and the IT group scored significantly higher than the ST group. The effect size was 1.06 for modality (N rather than IT and ST) and 0.48 for spatial contiguity (IT vs.

ST). These results also supported the notion that presenting visual content with verbal narration was more effective than on-screen text, regardless of its contiguity to the image.

On the final measure of efficacy, matching visual images and text, the N group averaged 93%, whereas the IT group and the ST groups averaged only 80% and 77%, respectively. The ANOVA revealed a significant main effect for the treatment group, $F(2, 119) = 18.632$, $MSE = 8.203$, $p < .001$. The N group scored significantly higher than the IT and ST groups. The IT and ST group scores did not differ significantly from each other. The effect size was 1.32 for modality (N vs. IT and ST) and 0.17 for spatial contiguity (IT vs. ST). Students' matching scores were classified as low or high on the basis of a median split *Chi-square* tests (with Yates correction) which revealed that the proportion of low-scoring students in the text groups (IT and ST) was significantly greater than the proportion of low-scoring students in the narration group, $\chi 2 (1, N = 122) = 141.38$, $p < .05$, but the proportion of low-scoring students in the ST group did not differ significantly from the proportion of low-scoring students in the IT group, $\chi 2 (1, N = 81) = .11$, $p = ns$. These results supported the Modality Principle but not the Spatial Contiguity Principle.

The Redundancy Principle

Mayer and Johnson (2008) revisited the earlier work of Mayer to examine the effect of redundant text on cognitive retention. They sought to determine if text placed on a screen near an image that was accompanied by a descriptive narration would enhance retention of knowledge. Specifically, in this experiment they included short phrases that highlighted key concepts form the narration, thus supporting the verbal channel with the same content in the visual channel. Mayer and Johnson expected to see a significant improvement in retention scores in the study. Ninety college age students participated in this study. The mean age was

18.29 years (*SD* = .75), and there were 58 women and 32 men. Forty-five participants served in the non-redundant group, and forty-five participants served in the redundant group. The non-redundant group saw a presentation on lightning formation with images and narration only (see Figure 10). The redundant group saw the same presentation with key words and phrases added alongside the images to support the narration. Each group was tested using a measure of content retention after the presentation, and a measure of content transferability to another situation.

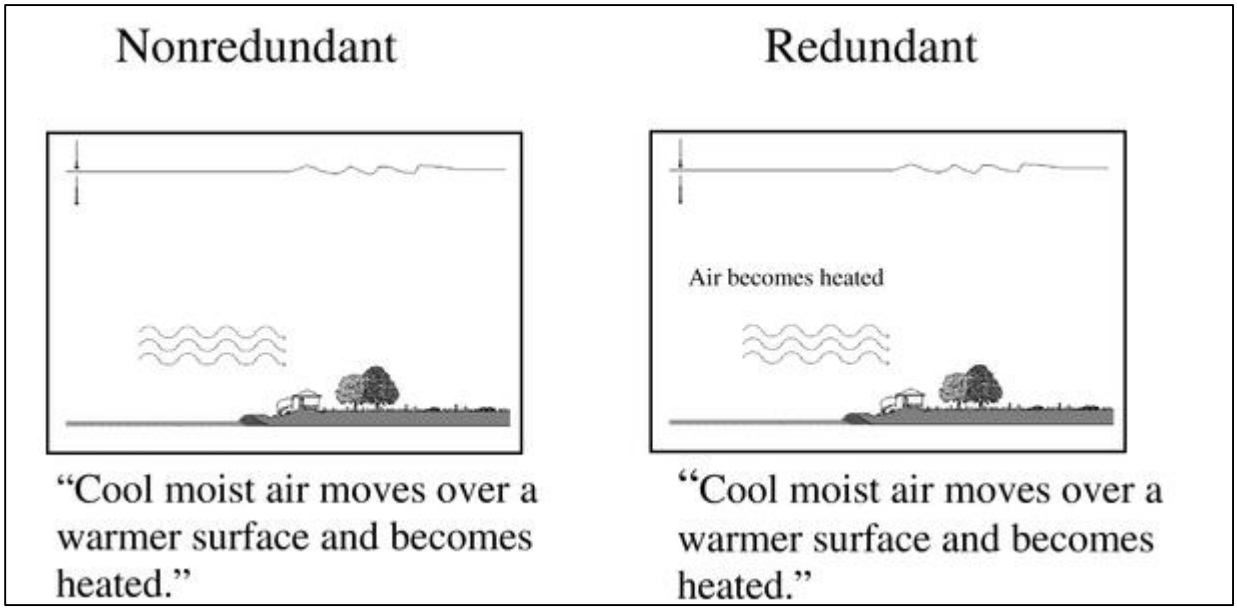

Figure 10. Redundancy Study Presentation

This figure depicts narration and animation without redundant text (left) and with redundant text (right). Redundant text highlights key points from the verbal narration. It does not present new information or new terms but supports existing information in the verbal channel.

Adapted from Mayer and Johnson (2008).

Independent samples *t* tests revealed that the redundant group (*M* = 8.02, *SD* = 2.83) scored significantly better than the non-redundant group (*M* = 6.69, *SD* = 2.87) on the

retention test, $t(88) = 2.22$, $p < .05$, $d = 0.47$. These findings were expected by the researcher and supported the redundancy principle. However, the redundant group ($M = 3.60$, $SD = 2.00$) and the non-redundant group ($M = 3.67$, $SD = 2.04$) did not differ significantly on the transfer test, $t(88) = 0.16$, $p = .88$, $d = 0.04$. Mayer and Johnson expected this result as well, and stated that it supported Mayer's earlier research on effective multimedia design (Mayer & Johnson, 2008). Specifically, narration was more effective than on-screen text in long term content acquisition.

The Coherence Principle

The final multimedia design principle is the Coherence Principle. This principle states that when presenting multimedia content, extraneous "bells and whistles" such as sound effects and background music detract from the overall learning effect. As stated earlier, each channel is limited in its capacity, and the potential for cognitive overload exists in both the verbal and visual channels (Sorden, 2005). When presenting essential information such as narration in the verbal channel, it is better to reduce or eliminate extraneous sounds and sound effects (Moreno & Mayer, 2000).

Moreno and Mayer (2000) studied this effect with 75 students recruited from the psychology department at the University of California at Santa Barbara. All students indicated that they lacked experience in meteorology. There were 19 students in the narration group (N), 18 in the narration with environmental sounds group (NS), 19 in the narration with music group (NM), and 19 in the narration with environmental sounds and music group (NSM). The median age was 18, and the overall percentage of women was 35%. Neither age nor gender differed significantly among the groups, $F(3, 71) = 2.10$, $MSE = 3.79$, $p = .11$, and $\chi^2 (3, N = 75) = 1.17$, $p = .75$, for age and gender, respectively.

As in the previous studies, students watched presentations in each group that matched the modality being tested. Tests measuring content retention, knowledge transfer, and verbal-visual matching were conducted after each session.

On the verbal recall measure, two-way ANOVA revealed that students remembered significantly less verbal material when music was presented (M = 7.65, SD = 3.73) than when no music had been presented (M = 11.37, SD = 3.29), $F(1, 71) = 21.99$, MSE = 11.61, $p < .0001$; there was no significant difference between students who had received environmental sounds (M = 8.87, SD = 3.73) and those who had not received environmental sounds (M = 11.37, SD = 3.29), $F(1, 71) = 2.30$, MSE = 11.61, $p = 0.13$. There was a significant interaction between music and sounds, $F(1, 71) = 4.41$, MSE = 11.61, $p < .05$, in which the combination of music and environmental sounds (NSM) had a negative impact on content retention. Supplemental Newman-Keuls tests ($\alpha = .05$) indicated that group NSM recalled significantly less information than each of the other groups and that group NM recalled significantly less information than groups N and NS. Groups N and NS did not differ from each other. These data indicated that adding extraneous sounds (music and sound effects) to a multimedia presentation had a negative effect on verbal recall of the content.

Similar results were obtained when examining the effect of sounds and music on knowledge transfer. A two-way ANOVA revealed that students generated significantly fewer solutions when music had been presented (M = 1.54, SD = 1.19) than when no music had been presented (M = 2.84, SD = 1.52), $F(1, 71) = 17.65$, MSE = 1.79, $p < .0001$. There was no significant difference between students who had received environmental sounds (M = 2.05, SD = 1.76) and those who had not received environmental sounds (M = 2.34, SD = 1.21), $F(1, 71) = 0.62$, MSE = 1.79, $p = 0.43$. There was a significant interaction between

music and sounds, $F(1, 71) = 4.41$, $MSE = 1.79$, $p < .05$, in which the combination of music and environmental sounds (group NSM) had a negative effect on knowledge transfer. Supplemental Newman-Keuls tests (with α at .05) indicated that group NSM generated significantly fewer solutions than each of the other groups and that group NM generated significantly fewer solutions than group N and group NS. Group N and group NSM did not differ from each other. It is worth noting that on this measure music alone had a detrimental effect, but sound effects alone did not. The interaction of music and sounds had a negative effect on knowledge transfer. These results largely supported the Coherence Principle.

The final measure of verbal-visual matching produced different results. A two-way ANOVA revealed no significant main effect for music, $F(1, 71) = 2.57$, $MSE = 2.45$, $p = 0.11$; no significant main effect for environmental sounds, $F(1, 71) = 0.98$, $MSE = 2.45$, $p = 0.33$; and no significant interaction between music and environmental sounds, $F(1, 71) = 0.18$, $MSE = 2.45$, $p = 0.67$. The matching test failed to produce effects that would allow us to support the Coherence Principle. Unlike the measures of content retention and knowledge transfer solving, the matching scores of the groups did not differ significantly from each other. The authors suggested that this was due to the fact that matching test was not a sensitive enough measure of the effect of students' learning processes (Moreno & Mayer, 2000).

One study (Moreno & Mayer, 1999b) examined the effect of representing a new mathematical concept using multiple forms of instruction in a multimedia application with elementary aged school children. These grade six students were introduced to the concept of adding negative numbers for the first time in this study. Sixteen problems were sorted into category by difficulty level. The students were divided into two groups. Group SR learned

the new math concepts using only one form of instruction on a computer application. Group MR learned using multiple forms in a similar multimedia application. Group MR learned the content significantly better, $F(1, 56) = 4.24$, $MSE = 10.21$, $p < .05$, than the SR students on problems categorized as difficult.

Attitude Toward School

Attitude toward school is a broad construct sometimes defined as a description of the orientation to school or school engagement. In the work of Jessor et al. (1995) as well as the work of Fredericks et al. (2005) the term *attitude toward school* was used to capture an affective sense of how the student felt about being in school with a quantitative measure. Attitude toward school is dependent on many factors, including the presence of different instructional models, amount of computer use, amount of homework and testing, and free time. In addition, increased exposure to computers can have a positive impact on attitude toward school (Henry, Mashburn, & Konold, 2007).

The construct *orientation to school* is used to group questions about how students feel about school, how much they value academic achievement, and the motivation level of the student. Orientation to school is used to rate the feelings of a student towards the school environment (Jessor et al., 1995). Orientation to school is a construct that defines how a student feels about going to school and what value the student sees in academic pursuits. In addition orientation toward school is a protective measure for adolescents. A positive orientation thwarts involvement in disruptive and harmful behavior and helps students to be a part of and involved in the school context. Attitude toward school is seen in terms of risks and protections. Risks are those behaviors that could cause harm to the child (physical, mental or emotional) and protections are those circumstances that can thwart risks and lead to

healthy development, such as strong inter-personal networks, presence of caring adults, and academic advancement (Jessor et al., 1995).

Fredericks defined *school engagement* as a feeling of connection to the school and affective feelings towards school (Fredericks et al., 2005). Engagement can be further classified as behavioral, emotional or cognitive. Behavioral engagement (or attitude) refers to the participation of the student in daily school activities. It classifies the student in terms of behavioral traits of cooperation, following rules, truancy, fighting, friendship, etc. The level of participation of the child in school activities is included here, as well as the involvement in extra-curricular activities. Emotional engagement (or attitude) refers to the student's reactions to teachers and peers in the school. It includes a student's identification with school and a feeling of belonging or isolation, a sense of being part of the school culture. Finally, cognitive engagement (or attitude) describes the child's effort towards comprehension; specifically, how hard the child works to learn and understand the content presented. Cognitive engagement is used to describe the commitment of the child to learning, the sense of challenge the child has, and the child's willingness to exert significant effort on the learning process (Fredericks et al., 2005).

The relationship between student and teacher has been identified as a key component of positive school attitude (Smith, Ito, Gruenewald, & Yeh, 2010). When teachers were supportive and maintained high expectations, students felt connected and encouraged and attitudes were positive. The construct attitude toward schools included several factors, including ways students felt, thought, and acted about and towards school (Holfve-Sabel, 2006). These attitudes were seen as separate and distinct from academic factors and cognitive traits. In fact, they were considered to be discrete, measureable traits that were

assessed using a variety of instruments, and were deemed to be just as important as the latter (Holfve-Sabel, 2006).

Children seem to prefer child-initiated activities including computer use, games, puzzles, and recess activities. They have a less positive attitude towards academic activities, homework, and tests (Henry, Mashburn, & Konold, 2007). Computer use in the classroom can be a motivational factor and lead to increased engagement and effort by students. Specifically, computer activities that are independent, challenging, and stimulating lead to increased effort by students and a positive attitude overall (Becker, 2000). There appears to be a strong correlation between use of classroom computers as an instructional tool aligned to the regular educational program, and increased student effort and positive attitude toward school. An extensive study of the Apple Classroom of Tomorrow (ACOT) program revealed increased engagement by students participating in a classroom computer technology initiative (Sandholtz, Ringstaff, & Dwyer, 1997). In the ACOT classrooms, computer use was aligned to the instructional program and activities were individualized and self-directed by students. These factors were important for students in determining relevance and interests in the activity.

Attitude toward school can be measured by a number of variables, including positive orientation to school, school attachment, school bonding, school climate, school connection, school context, school engagement, school involvement, student satisfaction, and student identification with school. Each variable has unique characteristics but all share in common an attempt to measure each student's internal relationship toward the school (Libbey, 2004). Each of these variables can be measured with unique and specific probing questions or statements, as shown in Table 1. The table shows some sample questions and statements

used to measure student attitude in a variety of instruments (Libbey, 2004). The table lists a number of phrases that can describe attitude toward school and the questions that could be asked to score each phrase.

Table 1

Sample Questions from a Variety of Attitude Measures

Adapted from Libbey, 2004

Variable	Sample Question\Statement
Positive Orientation to School	How do you feel about going to school?
School Attachment	People at school like me.
	I feel happy to be at this school.
	I feel like I am part of this school.
School Bond	Do you care a lot about what your teachers think of you?
	Do you like most of your teachers?
	Do you think most of your classes are important?
School Climate	Students get along well with teachers.
	Teachers are interested in students.
School Connection	I can be a success at school.
	I can be myself at school.
	I have friends at this school.
School Climate	The rules are enforced fairly.
	Students respect each other.

Attitude Toward Computers

Knezek (1996) purports that exposure to computers at an early age improves children's attitude toward school. Three researchers (Knezek, Miyashhita, & Sakamoto, 1996) conducted research in Japan and the USA to support this claim. Their research defines attitude toward computers as a combination of computer importance and computer enjoyment, both subscales of the YCCI instrument that defines the attitudes toward computers construct. They report no novelty effect for computer enjoyment and a weak novelty effect for computer importance. Computer enjoyment remains high or rises for students exposed to computers in the primary grades. Computer importance does decline each year from grades one to three but the change is not significant. Further, there appears to be no specific type of computer use that is more appealing to students. All computer use generates an improved attitude towards computers. There are some changes between attitude levels when using drill and practice vs. discovery learning situations but the difference is not significant (Knezek et al., 1996).

Research has also shown that among adults, computer ownership and use positively affects computer attitude (Cavas, Cavas, Karaoglan, & Kisla, 2009). There has been much research on the effect of computer use on student attitude toward computers. Beckers and Schmidt (2003) studied this with a sample of 184 first year college students in the fall of 1999. The mean age was 20.34 years, with a range of 19-39 years old. The sample included 138 students; 92 were female and 46 were male. All students received a small monetary compensation for participation in the study. Each student completed a questionnaire that was designed to measure seven constructs: nature of first computer use, support of first computer use, overall computer use, self-efficacy, computer literacy, physical arousal at use, and affect.

The study examined computer anxiety, defined as a negative computer attitude, in relation to each construct. The data were analyzed using a combined latent-factor path modeling method for structural equation modeling (Beckers & Schmidt, 2003). In addition, the researchers used the Average Absolute Standards Residuals (*AASR*) and Comparative Fit Index (*CFI*) to determine the statistical implications of the data. The results were: *Chi-square* = 146.90, *df* = 62, $p < .01$; *Chi-square/df* = 2.37. *AASR* = 0.06; *CFI* = 0.91. A combined latent-factor path model of the relationship between anxiety and computer use showed a good fit (*CFI* = 0.91), meaning that there was a direct, positive relationship between the two factors of anxiety and experience (Beckers & Schmidt, 2003). The less computers are used, the higher the anxiety, or negative attitude toward computers. The more computers are used, the lower the student's anxiety toward computers.

Other researchers have examined gender (Baloglu & Cevik, 2008) and class (Bovee, Voogt, & Meelissen, 2007) in terms of attitude toward computers. Research on gender, class, and attitude has shown both a correlation in some cases and no correlation in other cases, however research on computer use and attitude seems to consistently indicate that increased use leads to improved attitude among school age students and that there is a direct causal relation between the two (Levine, 1998).

Geissler and Horridge (1993) examined the effects of several variables on college students' attitude towards computers. Their study of students ($n = 790$) involved a researcher-developed questionnaire delivered to a random sampling of college students in the spring of 1990. Eight independent variables were examined: college enrolled in, year in college, grade point average, age, gender, high school computer class participation, college computer class participation, and computer ownership. These variables were matched to six

core competencies: function of the computer, computer as time saver, computer use, operating system use, programming skill, and effect on academic achievement. The researchers found varying relationships between all the variable-competency pairings; most importantly however, they found that students who had taken a high school computer class had significantly higher skills on all six core competencies. In addition, owning a computer (home use) was a strong predictor of a student's current computer competency and commitment to learn more about computers. To summarize, the more students in the study used computers at home and in school, the more positive their attitude toward computer use was.

It is suggested that student attitude toward computers effects behavior with computers, and that the reverse is true (Levine & Donitsa-Schmidt, 1997). Access to a computer at home relates to knowledge about computers and frequency of use of computers in school (Geissler & Horridge, 1993). In addition, there appears to be a correlation between exposure to computers and attitude toward computers (McQuarrie & Iwamoto, 1990). Levine and Donitsa-Schmidt (1997) surveyed middle and high school students (n = 309) from a random sampling of 10 schools. They administered a three-page questionnaire that examined attitude, computer use, demographic factors, and self-perception of computer knowledge. These variables were analyzed in relation to computer use at home, computer use in school, and overall computer use. The attitude questions used a 5-point Likert-type scale to measure student attitude toward computers. All three computer use variables (home use, school use, and overall use) showed a strong positive correlation to computer attitude. Correlations ranged from .13 to .50 for the three variables. The more the computer was used, the more positive the attitude toward computers (Levine & Donitsa-Schmidt, 1997).

The literature points to a general efficacy of CAI in the classroom, the need for specific strategies for presenting multimedia content as per the CTML, and a significant positive correlation between computer use and student attitude toward computers and school.

The present study, described in detail in Chapter 3, specifically addressed the latter item, the effect of student computer use on student attitude. In addition, the effect of one specific multimedia application, Destination Reading, on student reading comprehension, was examined in detail.

CHAPTER 3: METHODOLOGY

This study was conducted in a suburban school district with a sample selected from the entire population of third grade students. Prior to the commencement of the study, approval was received from the Institutional Review Board (IRB) at Western Connecticut State University to conduct research with minor children, as specified in the IRB proposal. The study commenced in September of 2012 and was completed by January 2013. Students from all 10 third grade classrooms formed the population of the study. Five classrooms were randomly selected as a control group and the remaining five served as the treatment group. All students completed the 2008 NYS ELA Exam Part 1 (NYS ELA) and the Young Children's Computer Inventory (YCCI) as pretests. Following the pretests, the treatment group was given instruction in the use of Destination Reading (2007), the software used to deliver targeted ELA instruction. The students used the software for 10 weeks in the classroom. During this ten-week period the control group students continued to receive traditional targeted ELA instruction. After the treatment was complete, both groups received the 2009 version of the NYS ELA Exam Part 1 and a re-ordered version of the YCCI instrument (see Appendix A). At this point the control group received access to Destination Reading (see Appendix B) for the purpose of equity.

Data were analyzed and five students (one from each treatment class) were purposefully selected based on the gain in ELA exam scores. One student from each treatment class who showed the largest positive gain on raw scores from pretest to posttest was selected to be interviewed. The researcher conducted one-on-one semi-structured interviews (Bogdan & Biklen, 2007) with each student to determine the effect of the use of the software on attitude toward school and attitude toward computers in a manner that

differed from what the YCCI instrument could provide. Five questions (see Appendix C) and follow up questions were asked of each student, aimed at getting a fuller sense of how the software use affected student attitudes. Data from the interviews were coded, analyzed, and triangulated with the quantitative data.

Description of the Setting and the Subjects

The site of this study was a medium-sized (< 3,000 students) suburban Mid-Atlantic school district that is within commuting distance of a major metropolitan area. The district is composed of five schools; three elementary schools, each serving grades K-5, one middle school serving grades 6-8 and one high school serving grades 9-12. The district's student population is predominantly White (75%), with a growing Hispanic population (11%), and small African- American (4%) and Asian-American (6%) populations. Within the district, 15% of students were eligible for free or reduced lunch, a number that has increased by 3% every year for the last three years. The district is in good academic standing with the exception of the students with disabilities subgroup in two schools, which did not make federally defined adequate yearly progress in 2010.

The population included the entire third grade, approximately 60 students from each of the three elementary schools (190 students total). The district had 10 grade 3 classrooms. Five classrooms were randomly selected for the treatment group, and the remaining five served as the control group. Sixty-nine students were in the treatment group and 57 students in the control group. Treatment and control groups were selected randomly as intact classes from each school as per Table 2. The specific numbers of treatment classes in each school were purposefully chosen in order to achieve a better balance of students from all demographic groups, given the varied makeup of the three elementary schools.

Table 2

Selection of Treatment and Control Classes from Grade 3 Population

School	Class	Students	Group
A	A-1	17	Treatment
A	A-2	16	Control
A	A-3	18	Control
B	B-1	22	Treatment
B	B-2	20	Treatment
B	B-3	19	Control
B	B-4	21	Control
C	C-1	18	Treatment
C	C-2	20	Treatment
C	C-3	19	Control

To facilitate the formation of equivalent groups, a specific number of treatment and control classrooms were selected from each school in a purposeful manner. This process was carried out based on the total number of English Language Learner (ELL) students and students in poverty in each school and estimated academic level of students.

Once the groups were formed and the pretest was administered, it was determined that there was no significant difference between treatment and control groups for two of the three variables measured. Specifically, an ANOVA revealed no significant main effect for reading comprehension, $F(1, 124) = .188$, $p = .665$ and no significant main effect for attitude towards school, $F(1, 124) = .562$, $p = .455$. For the variable attitude towards computers,

there was a significant difference between treatment and control pretest scores, $F(1, 124) = 8.696$, $p = .004$. The pretest difference between the group means for this variable was within 1 standard deviation and the groups were deemed equivalent for the purposes of meeting the assumption of equivalent groups for the MANOVA.

Table 3 illustrates the demographics for the entire third grade population in each school. Table 4 indicates the same type of data for only the students that participated in the study, also by school.

Table 3

Grade 3 Demographic Data by School (Population)

School	Count	Poverty	ELL	SpEd	Male	Female
A	51	19	6	5	26	25
B	82	13	4	10	43	39
C	57	4	5	9	26	31

Table 4

Grade 3 Demographic Data by School (Sample)

School	Count	Poverty	ELL	SpEd	Male	Female
A	37	7	4	5	17	20
B	46	7	2	3	22	24
C	43	0	2	8	18	25

Once the students were assigned to either of the two groups the demographic data were analyzed to determine differences among the groups. Table 5 compares the data for the two groups on the six criteria listed.

Table 5

Number of Students in Each Demographic Class by Group (Sample)

Group	Count	Poverty	ELL	SpEd	Male	Female
Treatment	69	5	5	12	29	40
Control	57	8	2	4	26	31

These data are presented graphically for comparison purposes in Figure 11. With the exception of special education status, all of the variables were within 12 percentage points of variation. It is worth noting that the purposeful method of selecting the number of treatment and control groups from each school was successful in balancing the number of students in poverty or eligible for ELL between the treatment and control groups. However, as can be seen in Figure 11, there was still a large difference between the number of special education students in the treatment group (12) and the number in the control group (4). This was of some initial concern, but as the pretest data revealed no significant difference in performance on the reading comprehension variable, a decision was made to leave these students in the study and not further manipulate the sample to make the number of special educations students in each group equal. A factor that was considered was the nature of the classification of each student. The specific classification for each student was not available. It is likely that the classifications covered a variety of conditions, including mathematical ability, classroom behavior, social-emotional issues, and difficulty with reading or language

arts. Given this information, it was not surprising that the results of the pretest showed no significant differences in reading comprehension score between groups. It is also worth noting that the academic support that these students received may have been effective in bringing them up to par with their non-classified peers.

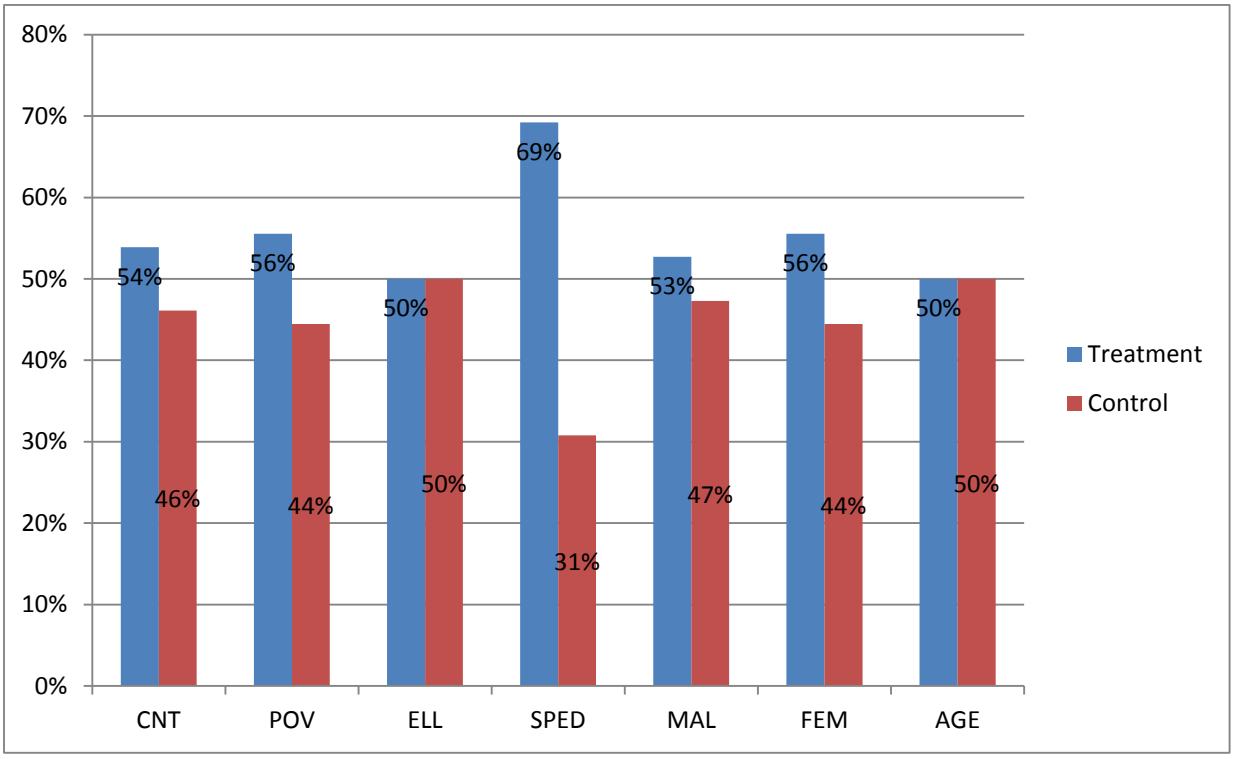

Figure 11. Grade 3 Sample Demographic Comparison by Group

The figure shows the percentage of students in the sample for each demographic group: CNT=total count, POV=eligible for free\reduced lunch, ELL=English Language Learner, SPED=special education student, MAL=male gender, FEM=female gender, AGE=average age.

Instrumentation

Two instruments were used, as well as semi-structured interviews. The 2008 and 2009 versions of the NYS ELA Exam Part 1 (NYS ELA) measured reading comprehension.

The Young Children's Computer Inventory (YCCI) measured attitude toward computers and attitude toward school. Following the posttest, the 5 selected students met with the researcher during the school day and the interview took place with specific questions follow-up as needed.

New York State English Language Arts Exam (NYS ELA)

Both the 2008 and 2009 versions of the New York State ELA exam were comprised of two parts. Part 1 included several short passages and a series of 20 multiple choice questions designed to assess student's comprehension of the passages. Part 2 assessed a student's listening and writing skills. Part 2 was not used for this study. Internal consistency reliability for the overall test is reported with a Cronbach's Alpha value of .86, and for the Part 1 items as .84 (NYS Testing, 2009). Both scores indicate this is a highly reliable instrument. Each test was examined by an independent auditor for content and construct validity and was determined to measure the desired standards in a valid manner (New York State Testing Program, 2009). Reliability measures are provided for subgroups as well. Cronbach's alpha scores for each subgroup are shown in Table 6.

Table 6

Reliability Scores on the NYS 2009 Grade 3 Exams

Subgroup	N-count	Cronbach's Alpha	SEM of Cronbach	Feldt-Raju	SEM of Feldt-Raju
State					
All Students	198123	0.86	2.11	0.87	2.04
Gender					
Female	96707	0.85	2.02	0.86	1.97
Male	101416	0.87	2.18	0.88	2.11
Ethnicity					
Asian	15808	0.83	1.88	0.84	1.84
Black	37517	0.86	2.30	0.87	2.23
Hispanic	42112	0.86	2.29	0.87	2.23
American Indian	934	0.84	2.28	0.85	2.22
Multi-Racial	642	0.83	2.02	0.84	1.97
White	101012	0.84	1.92	0.85	1.85
Unknown	98	0.84	2.00	0.84	1.95
Need-Resource Correlation					
New York	70202	0.87	2.21	0.88	2.14
Big 4 Cities	8193	0.87	2.41	0.87	2.33
High Needs Urban\Suburban	16107	0.86	2.22	0.87	2.15
High Needs Rural	11493	0.85	2.16	0.86	2.10
Average Needs	58500	0.84	2.01	0.85	1.96
Low Needs	29916	0.81	1.80	0.81	1.76

Table 6 (continued)

Reliability Scores on the NYS 2009 Grade 3 Exams

Subgroup	N-count	Cronbach's Alpha	SEM of Cronbach	Feldt-Raju	SEM of Feldt-Raju
Charter Special Status	3493	0.78	2.06	0.79	2.03
IEP	26929	0.87	2.57	0.88	2.48
504	45137	0.87	2.48	0.88	2.40
LEP	17491	0.86	2.48	0.87	2.40

The instrument was commissioned by the State of New York and developed by CTB/McGraw Hill for use by all grade 3 students in New York. It was designed to measure attainment of the New York Learning Standards for English Language Arts for students. Normally the test is administered over two days in grade 3. For this research, only Part 1 was used. It was administered in a single session of 40 minutes, as per the test administration guidelines (see Appendix D). These guidelines were adapted from the official New York guidelines to adjust for the fact that only Part 1 was administered. Students used equivalent forms of the ELA test for pretest and posttest. The pretest was the 2008 version and the posttest was the 2009 version. All questions were matched to a test blueprint to ensure content validity, and analysis of the blueprint-item matrix revealed that both versions of the test assessed the same standards (New York State Testing Program, 2009), thus supporting test validity. Only the 20 multiple choice questions from Part 1 were used from both tests. The item map for Part 1 (see Table 7) indicated that questions 1 through 20 measured a variety of reading comprehension skills and strategies (New York State Testing Program, 2009).

Table 7

New York State 2009 ELA Exam Item Map (New York State Testing Program, 2009).

#	Points	Standard	Performance Indicator
1	1	1	Determine the meaning of unfamiliar words by using context clues, dictionaries, and other classroom resources
2	1	1	Identify main ideas and supporting details in informational texts
3	1	3	Read unfamiliar texts to collect and interpret data, facts, and ideas
4	1	1	Evaluate the content by identifying important and unimportant details
5	1	2	Identify main ideas and supporting details in informational texts
6	1	2	Summarize main ideas and supporting details from imaginative texts
7	1	2	Use specific evidence from stories to describe characters, their actions, and their motivations; relate sequences of events
8	1	2	Use specific evidence from stories to describe characters, their actions, and their motivations; relate sequences of events
9	1	1	Make predictions, draw conclusions, and make inferences about events and characters
10	1	1	Read and understand written directions
11	1	1	Read and understand written directions
12	1	1	Read and understand written directions
13	1	1	Determine the meaning of unfamiliar words by using context clues, dictionaries, and other classroom resources
14	1	3	Use graphic organizers to record significant details from informational texts

Table 7 (continued)

New York State 2009 ELA Exam Item Map (NYS Testing, 2009).

#	Points	Standard	Performance Indicator
15	1	2	Evaluate the content by identifying important and unimportant details
16	1	2	Summarize main ideas and supporting details from imaginative texts
17	1	2	Use knowledge of story structure, story elements, and key vocabulary to interpret stories
18	1	3	Use specific evidence from stories to describe characters, their actions, and their motivations; relate sequences of events
19	1	3	Evaluate the content by identifying important and unimportant details
20	1	3	Evaluate the content by identifying the author's purpose

To demonstrate the common factor underlying student responses to NYS ELA exam items, a principal component factor analysis was carried out on a correlation matrix of single items for the exam. More than one factor with an eigenvalue greater than 1.0 present in each data set would suggest the presence of small additional factors. Analysis revealed that the ratio of the variance explained by the first factor to the remaining factors was large enough to support the claim that this exam was in fact unidimensional. These ratios showed that the first eigenvalues were at least four times as large as the second eigenvalues for this exam. In addition, total amount of variance accounted for by the main factor was examined. Analysis determined that all the New York State Grades 3 ELA Tests demonstrated first principle components accounting for more than 10% of the test variance. These findings supported the claim for construct validity of the exam, and the statement that scores did in fact parallel

proficiency on the desired NYS ELA standards. The authors considered bias when developing the exam, and took proactive steps to eliminate it. Specifically, the authors attempted to ensure that content validity was high and that there was minimal differential item functioning (DIF). Ensuring that there is limited DIF means that bias is limited, since a variety of students are experiencing the exam in a similar fashion. Second, the authors strictly adhered to the content writing guidelines produced by New York State. A team of four editors reviewed content and cross-checked each other's work. Third, a panel of New York State teachers reviewed all exam questions and evaluated the language for cultural or gender based bias. Finally, the authors used statistical analysis on all exam items to pinpoint any significant appearance of DIF. Such issues were examined and questions eliminated based on these data (New York State Testing Program, 2009).

New York State has devised a raw score to scale score conversion process for scoring the full exam. This was developed to ensure comparability across grades. However, for this research, only multiple choice questions one through twenty were used. Each question has an equal value of one point. This exam was scored on a scale of 0-20. Twenty points received indicated that all questions were answered correctly on Part 1 of the exam.

Young Children's Computer Inventory (YCCI)

The YCCI contains 51 items using a 4-point Likert-type scale in survey format (Knezek, 1992). It was designed for elementary children and can be administered online or on paper. Items are divided between seven independent sub-scales: Computer Importance, Computer Enjoyment, Study Habits, Empathy, Motivation, Creative Tendencies, and Attitude Toward School. Computer Importance and Computer Enjoyment were combined (as per the author of this instrument) to form the Attitude Toward Computers subscale

(Knezek, 2000) and the Attitude Toward School subscale was used intact, for a total of 15 questions. Internal consistency reliability of six sub-scales (excluding Attitude Toward School) is based on Cronbach's Alpha and reported at .76 (Knezek, 2000) for grades 1-3, with a range of .66-.85 for individual sub-scales. Regarding validity of the instrument, the authors stated that the YCCI is valid as a result of three specific actions that were taken in the development of the instrument. Content validity was assessed by approximately 12 content-area experts in the field who reviewed the wording and selection of the questions in the YCCI. Construct validity was determined using factor analysis, and the YCCI was deemed stable over time and consistent across cultures. Criterion validity was assessed using analysis of variance and discriminant function results, which indicated that the YCCI does in fact distinguish between groups of students with differing attitudes (Knezek & Miyashita, 1993).

The subscales Study Habits, Empathy, Motivation, and Creative Tendencies were not administered for this study as only selected subscales may be used to address specific constructs (Knezek, 2000). This instrument was chosen because it best fit the researcher's needs for a survey tool that was brief, appropriate for the grade level, and measured the specific constructs considered in this study.

The exam was scored by assigning each statement a maximum of 4 possible points. Assuming a score of 4 on each statement, the maximum score was 60 points. Eleven of the statements are part of the attitude toward computers subscale, and 4 belong to the attitude toward school subscale. Each statement was scored as per the YCCI Scoring Manual (see Appendix E).

Table 8

Typical Standard Scoring of Individual Item on the YCCI (Knezek, 1992)

Item	I know that computers give me opportunities to learn many new things.			
Student Selection	NO	MAYBE NO	MAYBE YES	YES
Points Allocated	1	2	3	4

Three questions had negative wording, such as "When I grow up I would not like to work in a school." For these questions the points were reversed as in Table 9.

Table 9

Typical Reverse Scoring of Individual Item on the YCCI (Knezek, 1992)

Item	When I grow up I would not like to work in a school.			
Student Selection	NO	MAYBE NO	MAYBE YES	YES
Points Allocated	4	3	2	1

Semi Structured Interviews

Semi-structured interviews are designed to allow the researcher to address certain topics while allowing space for the interviewee to embellish or add information as needed (Creswell & Plano Clark, 2011). Five interview questions were developed for this study to accomplish this goal. The questions were designed to develop a clear understanding of the perceptions of the students regarding how the treatment affected their learning and attitude, and to ensure that each child could speak freely about the entire process. See Table 10 for the specific interview questions used.

Table 10

Qualitative Interview Questions for Research Question Two

Qualitative Interview Questions
Please describe what it was like for you to use the Destination Reading software.
Do you think the use of the software changed how you feel about school? How?
Do you think the use of the software changed how you feel about computers? How?
Do you think the software helped you to learn to read? How?
Is there anything you would like me to know about using the software?

Description of the Research Design

This study used an overall mixed method design that was explanatory sequential (Creswell & Plano Clark, 2011). The quasi-experimental, quantitative data collection was conducted with equivalent groups (treatment and control) and a pretest-posttest design was used. In addition the study included a qualitative component based that used interviews with selected students and an explanatory sequential design. After the quantitative data were analyzed, five students were selected from the treatment group. The selection criterion was the greatest positive change in reading comprehension scores by one student in each treatment class. This criterion was implemented to determine what factors most affected the students who showed the greatest academic gain during the study. The issue explored was regarding what these five students experienced during the study that may have facilitated their academic change. For the quantitative portion of the study the dependent variables (DV) were reading comprehension, attitude toward computers, and attitude toward school. The independent variable (IV) was type of instruction, with multimedia applications and

without multimedia applications. Semi-structured interviews took place in order to facilitate the data analysis process with third grade students. The interviewer used warm up questions that were designed to relax the interviewees (Bogdan & Biklen, 2007) and recorded each session in order to be able to transcribe everything at a later date.

Using this design format, the research took place in seven phases. The research began with Phase 1, quantitative data collection. This phase included initial data collection used to determine group equivalency. During Phase 2 the treatment was implemented. In this phase the researcher trained students and teachers to use the reading software and scheduled time in the computer labs for each for the treatment classes. At the conclusion of the treatment, Phase 3 began with quantitative data collection. Here the effects of the treatment were measured using quantitative instruments. Data analysis was conducted in Phase 4. These data were used to help select the sample for the subsequent phase, which was qualitative sampling. Phase 5 included a sampling of the treatment group in order to select interviewees, based on the quantitative data analysis. This was followed by Phase 6, qualitative data collection from the sample in the form of interviews. The final phase included integration of the qualitative and quantitative data, Phase 7. This design is depicted graphically in Figure 12.

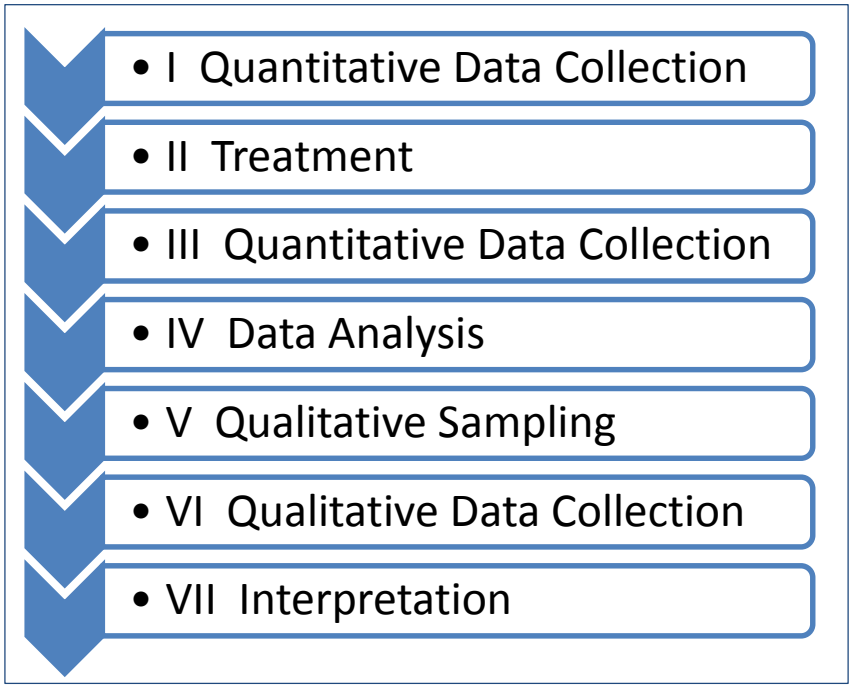

Figure 12. Overview of the Explanatory Sequential Design

Adapted from Creswell and Plano Clark (2011).

Five classrooms from the sample were randomly assigned to the treatment group and five classrooms were randomly assigned to the control group. Each student in the treatment group received 10 weeks of targeted ELA instruction using multimedia software applications. The targeted ELA instruction using multimedia software took place 3 times per week for 10 weeks in the school setting (30 minutes per session). This occurred in the computer lab and/or in the classroom in a small group setting. The homeroom teacher of each class received training from the researcher on using the software and the researcher accompanied each class to the first session in the lab to train students and ensure access by all students. Each student was scheduled to receive a total of approximately 15 hours of instruction using the multimedia application. The application included reporting tools that allowed the researcher to monitor progress of each student.

During the 10-week treatment period there was a major weather event that closed schools in the area for a full week. This not only shortened the treatment period, it presented real disruptions to the students and staff. Many meetings were rescheduled or cancelled, academic time was lost, and teachers were frustrated by this loss of time. The researcher attempted to make up the missed time but was not successful. Each classroom gave up approximately 3 sessions of instruction with the software, or about 10% of the planned time. This may have affected the study outcome and is presented as a limitation of the study later in this chapter.

The control group received the 2008 NYS ELA and YCCI exams as a pretest and the 2009 NYS ELA and a re-ordered version of the YCCI as a posttest 10 weeks later, after no change in instructional practice. The treatment group received the 2008 NYS ELA and YCCI exams as pretests. They then received 10 weeks of targeted ELA instruction using instructional software applications. After this occurred they received the 2009 NYS ELA and a re-ordered version of the YCCI exam as posttests. The population was conveniently selected from grade3 students in a specific suburban school district. Letters and forms were sent home to all parents requesting permission to include their children in the study (see Appendix F). Telephone calls were made to parents that returned incomplete forms to clarify their intention, and as a result an additional nine students were added to the study subsequent to tallying of all consent forms. From a total population size of 178 students, a sample size before posttest data analysis of 122 students was obtained. Sixty-five percent of the parents of grade 3 students returned consent forms for the study. Only two parents specifically refused consent; the remainder of parents either did not return the consent form or returned it incomplete.

This was a mixed-method study using quantitative and qualitative components. The quantitative design was quasi-experimental with a pretest and posttest, a treatment group and a control group. Random assignment of groups was used to ensure equivalent groups; however, the quantity of treatment and control groups was purposefully varied for each school to ensure a balanced demographic sample between treatment and control groups. The quantitative quasi-experimental design is depicted in Table 11.

Table 11

Description of Quasi-experimental Design for Targeted ELA Instruction

Group	Pretest	Treatment	Posttest
Treatment	O	X	O
Control	O		O

The qualitative portion of the study was conducted after the posttests were administered and data were analyzed. One student was selected from each classroom in the treatment group. The student who showed the greatest gain in reading comprehension in each treatment class was purposefully selected for an interview. These five students were interviewed by the researcher using a semi-structured interview process (Creswell & Plano Clark, 2011). This process involved the preparation of written questions (see Appendix C). Each of the students responded to the same five questions, but depending on the answers, follow-up questions were asked that added to or elaborated on the responses. The follow-up questions were created spontaneously with the goal of achieving greater clarity or detail from the student when these attributes were lacking.

Description and Justification of the Analyses

For the first dependent variable, reading comprehension, each exam was scored based on the New York Stare scoring guide (New York State Testing Program, 2009). Students received one point for each question answered correctly. Each student received an ELA score of 0-20 based on the number of correct answers. These data were entered into a statistical analysis program (SPSS) using coded student identification numbers. The YCCI was scored as per the scoring manual (Knezek, 1992) and each of the two sub-scale scores were entered in SPSS in a similar fashion. This entailed scoring each statement on a scale of 1-4. Three of the YCCI questions were negative statements (i.e., "School is boring") and were reverse scored as per the scoring guide (Knezek, 1992). Mean differences were calculated for each of the two YCCI subscales targeted for this study and the ELA raw scores using a MANOVA analysis. As noted elsewhere, there were two research questions in this study, a quantitative question and a qualitative question. Two instruments were used in this study. Both the NYS ELA and the YCCI were used as pretest and posttest instruments. The alpha level for determining significance in this study was set at $p <= .05$ due to the nature of this educational research and the analysis methods used. Results at or below the .05 level would be considered significant.

Interview responses were transcribed and manually entered into the qualitative analysis software (HyperRESEARCH) where they were analyzed for themes and patterns. Each theme is represented in this report with key words and word counts.

Research Question One

Is there a significant difference in the reading comprehension, attitude toward computers, and attitude toward school of students who receive targeted ELA instruction

using multimedia applications and those who receive targeted ELA instruction without multimedia applications?

Research Question One was a quantitative question and included one independent variable (type of instruction) with two levels (treatment and control). There were three dependent variables (reading comprehension, attitude toward school, and attitude toward computers). A Multivariate Analysis of Variance (MANOVA) was used to determine if there was a significant difference between the dependent variable scores in the two groups (treatment and control).

Research Question Two

What are the perceptions of students who use multimedia applications in school and show the greatest gain in reading comprehension after the study treatment period?

Research Question Two was a qualitative question regarding student perceptions. Interviews were recorded and transcribed. Data analysis was completed on the written transcripts as per Bogdan and Biklen (2005). Within each answer recurring word or ideas emerged which were coded in the software. This process involved looking for recurring key words in the text between and within the five interviews. The context of these key words was considered, and after identifying a dozen codes, three themes organically emerged. In some cases the same word was applied to different themes. For example, the word "new" might refer to the experience of fun using the software because it was new, or a new feeling the student was having. Given the limited vocabulary of the third grade students this categorization of similar words in multiple themes was common. However, the full context of each word was considered to be a key descriptive attribute when assigning a word to a theme. Thematic labels were determined and revised as needed once the interviews were

reviewed. Results were audited and confirmed by an independent researcher who reviewed the transcripts and concurred with the coding used.

Treatment

The treatment took place over a 10-week period in the fall of 2012. Each of the five classes was scheduled to use the computer lab for 3, 30 minute sessions per week. After the first session with the researcher, teachers brought their classes to the lab independently. Students logged on to the network and the software using unique usernames and passwords provided by the researcher. After accessing the software, students used headsets to listen to the audio portion of the software and used the mouse and keyboard to interact with the software. All activity for students was logged in an administrative application. In several instances it appeared to the researcher that specific classes were not accessing the software as often as planned. In these cases the researcher spoke with the individual teachers to encourage them to stay on the planned schedule for computer lab use. Additional instruction was offered to all students and teachers when questions arose. Destination Reading (2007) had three levels: 1, 2 and 3. A few students were assigned at Level 1 (grade K-1), most were assigned at Level 2 (grade 2-3), and a few were assigned at Level 3 (grade 4-5) depending on teacher input at the start of the treatment period. Mid-way through the treatment period a number of students had completed all activities in Level 2 of the software. These students were identified and they were assigned to Level 3. In these classes the researcher went back in to the classroom to demonstrate Level 3 for the students. No students completed Level 3. The administrative interface was monitored weekly for student progress and action was taken where necessary to ensure students were getting adequate time using the software.

Study Timeline

The study took place between September 2012 and January 2103. Prior to commencing the research, approval was granted by the Institutional Review Board (IRB) of Western Connecticut State University. The IRB approved the study in August of 2012 after reviewing the research proposal, including a description of the parental consent and student assent process.

Data collection began shortly after consent was granted at the end of September. Within one week of the return of all consent forms, treatment and control groups were selected and the pretest was administered to all students. Each instrument was administered by the researcher in each classroom using a scripted process to ensure that the testing protocol was consistent between groups. The ELA exam was administered using previous exams; the pretest was the 2008 exam and the posttest was the 2009 exam. The YCCI was administered using two equivalent forms, one for the pretest and one for the posttest, with the order of questions changed by the researcher.

Once the pretest was administered the treatment began immediately. Quantitative data analysis took place in December of 2012 following the posttest administration. Qualitative data analysis took place in early January of 2013 following the interviews. Further details are displayed in Table 12.

Table 12

Study Timeline

Date	Item
June 15-25, 2012	Information sharing sessions with teachers and administration
August 30, 2012	Application submitted to IRB
September 20, 2012	Distributed administrative consent forms
September 27, 2012	Distributed parental consent forms at Open House
October 5, 2012	Deadline for return of all consent forms
October 9-12, 2012	Pretested both groups and began treatment
December 17-20, 2012	Posttested both groups and ended treatment
December 30, 2012	Preliminary quantitative data analysis completed
January 2-4, 2013	Conducted student interviews

Limitations of the Study

Internal Validity

Internal validity is related to controlling all extraneous variables and being reasonably certain that the results of the study are influenced by the variable that the researcher is manipulating (Gall, Gall, & Borg, 2007). Some of the threats to this validity are listed below. Internal validity was approached in this study because there was reasonable certainty that only the treatment was affecting reading comprehension differences between the two groups.

History. Although the study took place during the same 10-week period for both treatment and control groups, and in similar schools within the same district, one school has a

slightly dissimilar demographic. There was a concern that this might have had an effect on pretest group equivalence and instrument administration. However, the quantity of classes chosen to be used as treatment groups from each school was adjusted to approach closer group membership equivalency in terms of poverty, ESL status, and special education status. With the exception of special education status, all of the other demographic groups were reasonably equivalent in terms numbers of students in treatment and control groups and overall percentage in each group. In addition, in this district, curriculum is mapped and the content presented in each classroom was analogous during the 10 week period. It is worth noting that during the 10-week treatment period the area of the schools used for this research was subjected to widespread power outages and road closures as a result of a hurricane, which disrupted school for a full week. All schools were closed for five days and many families were without power at home for longer. This did reduce the treatment period and may have caused some emotional turmoil for some students, but the effect would have been similar on both the treatment and control groups. In addition, the posttest took place the week after a tragic school shooting in Newtown, CT. The district is within a one hour drive to Newtown. Staff members were visibly shaken and school security was heightened. How this affected students during the posttest administration is a limitation of unknown effect.

Testing. All students received the same valid and reliable instruments for pretest and posttest. In addition, all tests were administered by the researcher to ensure uniform testing procedure for all students. Strict adherence to testing procedures ensured near-identical testing situations.

Instrumentation. Only valid and reliable instruments were used for the quantitative portion of the study (Research Question 1), and the same individual administered all tests.

Differential selection. One school has a somewhat different demographic background than the other two. This may have been an issue in this study because of lower academic skill levels of some students in this school. Pretest data was analyzed to determine group equivalency on the three dependent variables and to control for this threat. There was no significant difference in pretest scores between treatment and control groups. In addition, the number of treatment and control groups selected from each school was purposefully adjusted to ensure that each group had a similar academic and demographic profile. This procedure was successful with the exception of special education status, as mentioned previously.

Experimental mortality. The sample was large enough to allow for a few students moving out of the district or not participating in the study. There was still ample data for statistical analysis with a final sample size of 128 students. This was reduced to 125 students due to absences and moves out of the district, and then further reduced to 119 once outliers and missing data were eliminated.

Selection-maturation interaction. All students were in grade 3 and were tested during the same week for both the pretest and posttest.

Experimental treatment diffusion. Teachers in the control group knew that their students may have done less well on the posttest and may have compensated for this. Access to the software was restricted to the treatment group only, so control group students were not able to login to Destination Reading until after the posttest was complete. Since treatment and control groups were intact classes, discussion between students in each group was less than if they were randomly selected from the entire third grade population and mixed in each class.

Compensatory equalization of treatments. Teachers and district administration understood that all students received the same treatment, although with a 10-week time lag for the control group.

External Validity

External validity is a measure of generalizability. Specifically, this study measured how well the results of this study can be applied to other populations.

Population. It is expected that results of this study can be generalized to districts with similar demographics. The district was not diverse enough and the sample was not large enough to generalize across different ethnic, cultural, home language, and socioeconomic groups.

Ecological. As the researcher administered all instruments and led the student training for the first session, it is likely that this study will be fully replicable. A script was used for the instrument administration and the training on the software.

Multiple-treatment interference. Only one treatment was implemented. No other school-based initiatives were implemented during the treatment period.

Hawthorne effect. Students knew that they were being assessed and were receiving special software. They may have been likely to overachieve based on this information. In addition they may have overrated their engagement and attitude self-assessment in the YCCI. To counter this effect the researcher emphasized that the purpose of the study was to assess the program, not the students, and that they should be honest and natural in their participation. In addition, the research design ensured that this affect would apply to both groups in the same manner.

Novelty and disruption effects. The novelty of having the researcher in the classroom was likely to cause some disruption to the classroom culture. In addition, the researcher was known in the schools and many students were familiar with him in general terms as he was often introduced by teachers when in classrooms. This was equalized by his being present in both groups, but the treatment group saw the researcher for an additional session of training on the software prior to the posttest.

Experimental effect. As the software was delivered in a consistent manner, the only variable was bringing students to the computer lab. Once they were logged in, the experience was the same for all students. All students began the software at the same point in time and progressed through the application at their own pace with teacher support and oversight, and ended the treatment within the same week..

Pretest sensitization. Grade 3 students had not received the NYS ELA exam by October; this was their first exposure to it. It was a new experience which may have affected the results.

Posttest sensitization. The NYS ELA exam posttest was a different version than the pretest. It may have been easier for students to complete after they took the pretest and understood the testing protocol. This affected all students equally. However the YCCI was administered twice. Alternate (re-ordered) versions were administered but the questions were the same in both instances. After 10 weeks the questions may still have been familiar to some students, and they may have attempted to match or surpass their previous responses.

Interaction of treatment and history effects. The short time frame of the treatment minimized this threat. Kulik and Kulik (1991) indicated that shorter treatment durations were more effective than longer. This treatment was 10 weeks long.

Measurement of the dependent variable. A MANOVA was used to measure mean differences of each DV (reading comprehension, attitude toward computers, and attitude toward school) after group equivalence was determined using ANOVA analysis of the pretest data.

Interaction of time of measurement and treatment effects. Each posttest was administered only once and all students received it within the same one-week period of time.

Researcher bias. The researcher made every effort to put aside his desires for the outcome of the study and his biases towards the use of instructional technology tools. Additionally, the treatment was administered by trained classroom teachers with no stake in the outcome of the study.

Qualitative Trustworthiness

Trustworthiness with regards to qualitative research is a measure of how useful, worthy or relevant the research is. Unlike quantitative research where validity and reliability are the standard upon which the research is measured, in the qualitative realm researchers look for a study with a high degree of trustworthiness. Trustworthiness is assessed by using the four factors below.

Credibility. Peer review of the raw qualitative data was conducted with the student's home room teacher to detect any anomalies. Member checking was carried out with all the interviewees. The researcher met again with each student after the interviews were transcribed and read back the notes to ensure they captured the students' thoughts accurately. This member-checking process was implemented to ensure that the results obtained by the researcher did in fact match the intention of the student interviewee.

Transferability. Data were maintained on the demographic background of the entire sample.

Dependability. Transcripts of each interview were maintained and reviewed with a colleague who was a teacher in one of the schools in the study. She provided feedback on the overall design and implementation of the study with regards to this particular student population.

Confirmability. The researcher's bias was clearly identified in the study. The colleague mentioned above completed an audit of transcripts, and an analysis of qualitative documents to ensure confirmability based on qualitative research protocols.

Statement of Ethics

Written permission to participate in this research was granted by the Superintendent of the district where the study took place (see Appendix G) and each school Principal (see Appendix I). All parents received an information packet describing the study and were asked to return a form regardless of participation. Parents provided consent for their children to participate in the study or opted out on the form. The information packet was sent home in Spanish in cases where the researcher knew that Spanish was the home language of the parents. All students assented to the study (see Appendix H). To assure confidentiality, each participant was assigned a coded identification number. Summary data (without any student identifiers) were made available to the public, the Board of Education, Superintendent and Principals upon the completion of the study. A narrative overview of the study was shared with these same groups and individuals at a public meeting and on the district website. All identifying data were held by the researcher in a secure location using modern data encryption techniques.

The questions posed in Chapter 3 were answered by the data analysis and the interview responses were coded and explained. Chapter 4 presented descriptive statistics from the study, a description of the data analysis procedures, and an analysis of the data.

CHAPTER 4: ANALYSIS OF DATA

The purpose of this study was to investigate the specific effects of targeted ELA instruction using multimedia applications. This study assessed the effect of targeted ELA instruction using multimedia applications on student reading comprehension, student attitude toward computers, and student attitude toward school, and examined the perceptions of the use of these applications of 5 selected students from the treatment group.

In this study, all grade 3 students in a medium-sized suburban school district received 10 weeks of targeted ELA instruction using traditional teacher-directed methods. From this population, approximately half of the students received instruction with ELA multimedia applications in lieu of a portion of the allotted ELA teacher-directed instruction time. Two instruments were administered to all students as a pretest and as a posttest; the 2008 and 2009 versions of the New York State English Language Arts Exam Part 1 (NYS ELA) and two versions of the Young Children's Computer Inventory (YCCI). In addition, 5 students (one from each treatment class) were purposefully selected for a semi-structured interview. The interviews explored the perceptions of the students who used the ELA multimedia applications in school and showed the greatest gain in reading comprehension scores at the conclusion of the treatment period.

Pretest Analysis

Data cleaning and a preliminary ANOVA were completed on the pretest scores to determine equivalency of groups. Prior to this the assumptions necessary for the use of the ANOVA were addressed, as below.

Code and Value Cleaning

There were two missing cases in the pretest data. Data for these cases were deleted via listwise deletion.

Identification of Pretest Outliers

Pretest data for each variable were created using the statistical software package SPSS. These data were analyzed for normalcy. As all skewness and kurtosis values were within -1 and +1, outliers were not identified and were not removed as per the pre-determined data analysis protocol.

Assumption of Independence

For the pretest assessment in this study, the students in the treatment group were distinct from the students in the control group, and thus independent. In addition, they were assessed separately using the same instruments, and each class was randomly selected as treatment or control group member. The assumption of independence was thus met for the pretest assessment of the treatment and control groups.

Normal Distribution of Pretest Data

An assumption of Normalcy was made based on data that were plotted using the histogram function of SPSS with a normal curve overlay to visually verify normalcy of the data (Meyers et al., 2006). Descriptive statistics tables were used to verify skewness and kurtosis values. Figures 13-15 show the distribution of scores for each dependent variable in each group for the pretest measures.

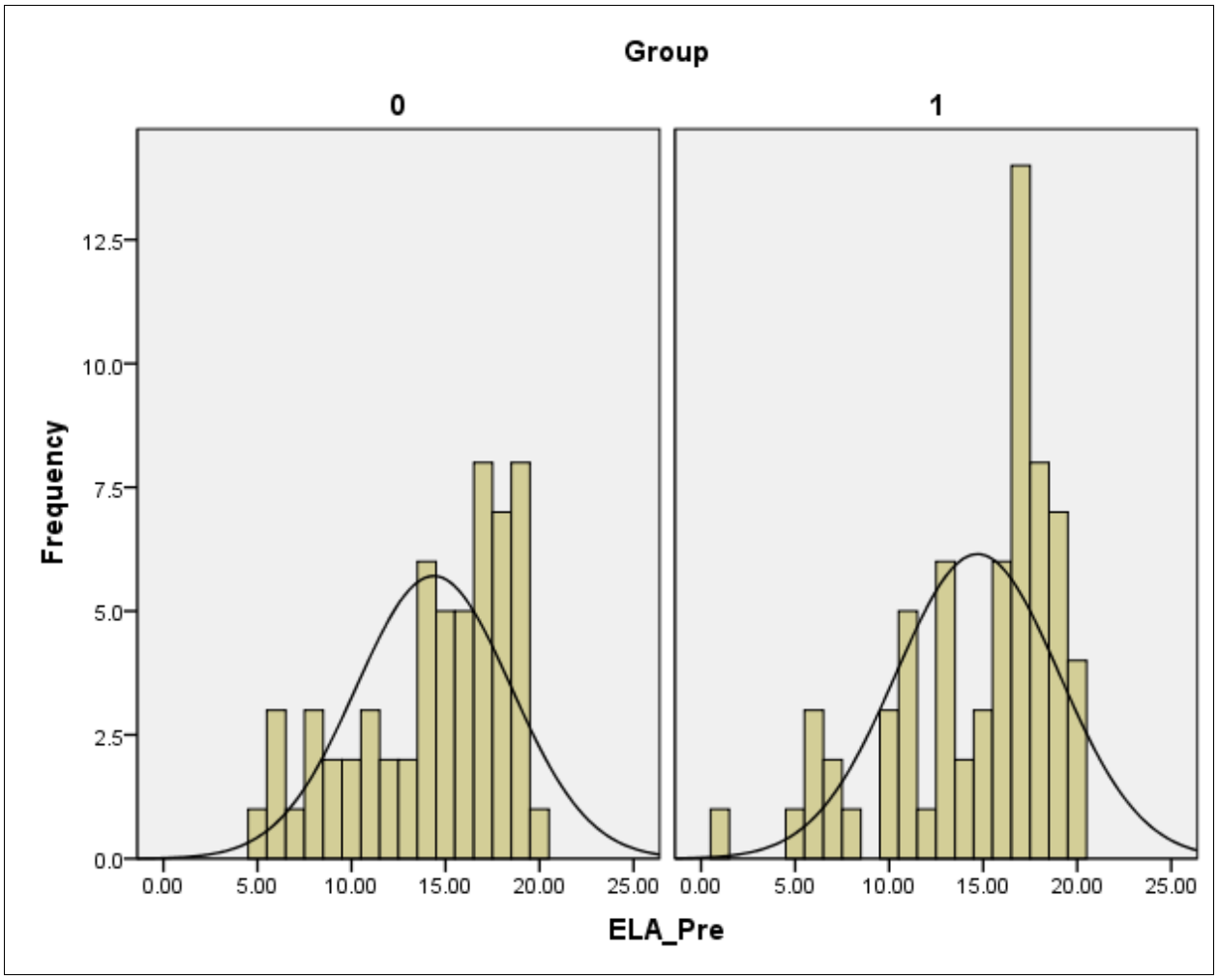

Figure 13. Pretest Histogram of Reading Comprehension Scores for Control (0) and Treatment (1) Students

The figure depicted all scores within the normal range. All skewness and kurtosis values were between -1.0 and + 1.0 and thus the distribution was deemed normal.

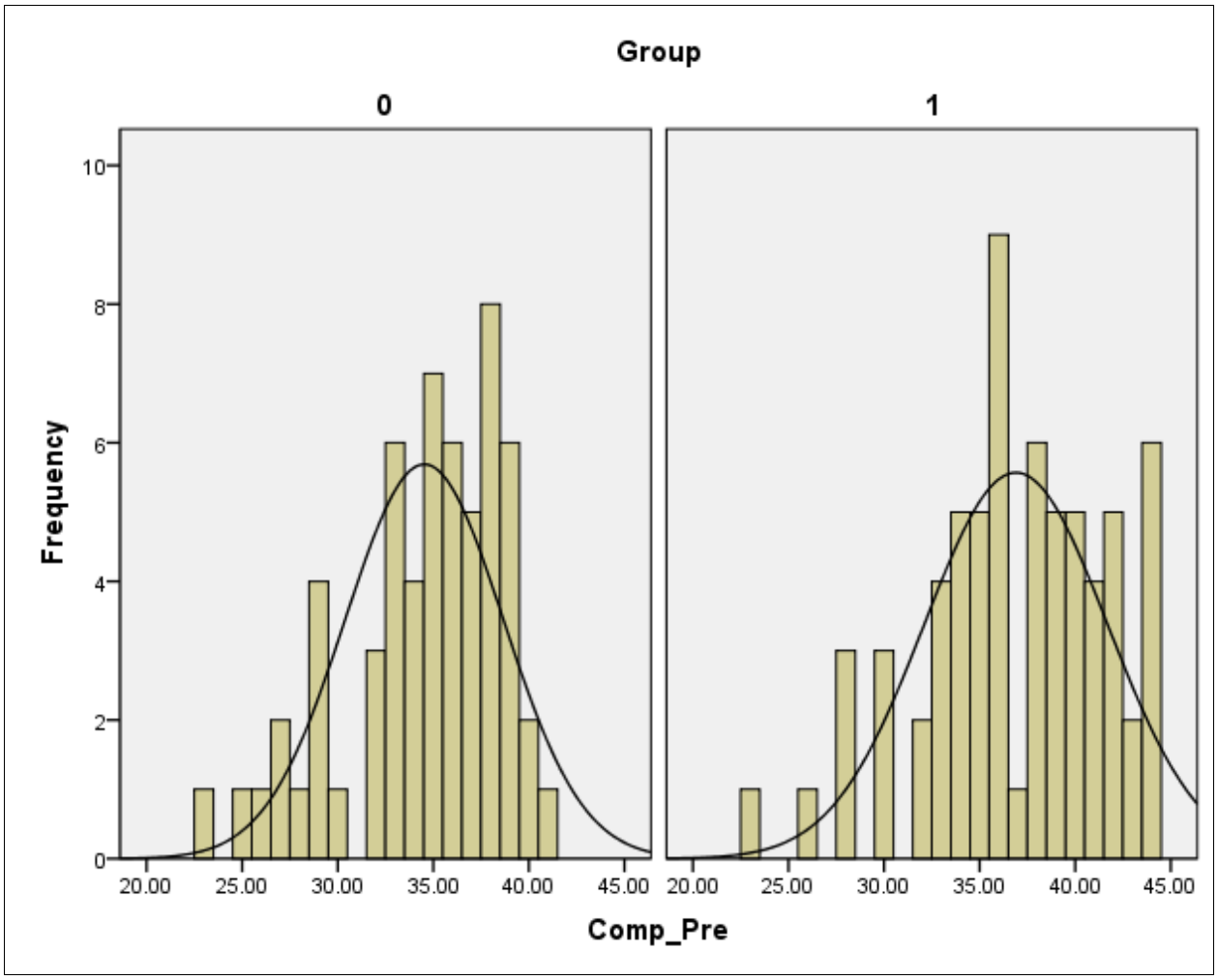

Figure 14. Pretest Histogram of Attitude Toward Computers Scores for Control (0) and Treatment (1) Students

The figure depicted all scores within the normal range. All skewness and kurtosis values were between -1.0 and + 1.0 and thus the distribution was deemed normal.

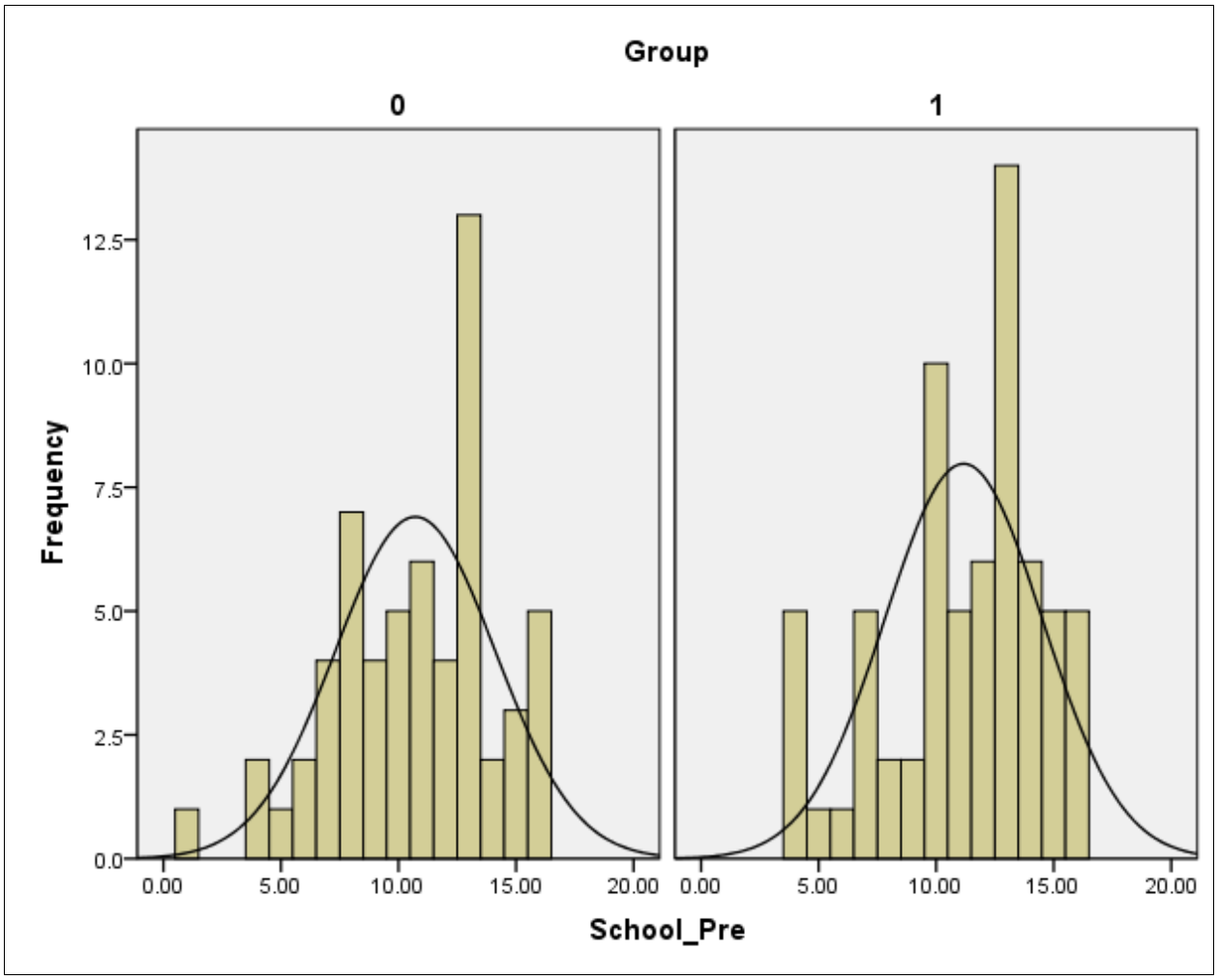

Figure 15. Pretest Histogram of Attitude Toward School for Control (0) and Treatment (1) Students

The figure depicted all scores within the normal range. All skewness and kurtosis values were between -1.0 and + 1.0 and thus the distribution was deemed normal.

Homogeneity of Variances

Levene's test was conducted on the pretest data for the treatment group and the control group for each variable. Results of the analysis revealed that the assumption of equal variances between each group was met at the $p < .05$ level for the pretest data. Therefore, the assumption of homogeneity was met, and the variance values between treatment and control groups for each variable were not significantly different, thus supporting the use of the ANOVA procedures to determine pretest equivalence of groups.

Table 13

Levene's Test Computation on Pretest Data for Variable Reading Comprehension

	Levene's Test of Equality of Covariance Matrices
Levene's Test	
F	.104
Df1	1.000
Sf2	124.000
Sig.	.748

Table 14

Levene's Test Computation on Pretest Data for Variable Attitude Toward Computers

	Levene's Test of Equality of Covariance Matrices
Levene's Test	
F	1.554
Df1	1.000
Sf2	124.000
Sig.	.215

Table 15

Levene's Test Computation on Pretest Data for Variable Attitude Toward School

	Levene's Test of Equality of Covariance Matrices
Levene's Test	
F	.051
Df1	1.000
Sf2	124.000
Sig.	.821

Following the analysis of the assumptions for the ANOVA procedure, the ANOVA was completed on all pretest scores and these data revealed that the treatment and control groups were equivalent on two variables and showed a significant difference on one variable prior to the treatment implementation. There was no significant difference between pretest ANOVA data on the NYS ELA reading comprehension score or on the YCCI attitude toward

school score. The attitude toward computers ANOVA revealed a small but significant difference between pretest scores of the treatment and control groups.

Specifically, the ANOVAs revealed no significant main effect for reading comprehension, $F(1, 124) = .188$, $p = .665$ and no significant main effect for attitude towards school, $F(1, 124) = 562$, $p = .455$ with an alpha level set at .05. For the attitude toward computers ANOVA, there was a significant main effect, $F(1,124) = 8.696$, $p = .004$. The researcher analyzed the difference between the group means for this variable and determined that they were within 1 standard deviation. A decision was made to deem these variables equivalent for the purposes of determining group equivalency prior to the treatment implementation.

As mentioned previously, the unequal numbers of special education students in the treatment and control groups was a concern. However, the ANOVA data revealed no significant difference in performance on reading comprehension, they key construct of this study, so the issue was not remediated.

Assumption of Normalcy of Pretest Data

Data were reviewed for each variable by group to verify normalcy. All skewness and kurtosis values were within -1.0 and + 1.0 for all groups and all variables, as per table 16.

Table 16

Pretest Descriptive Statistics for Normalcy Verification of Each Group and All Variables

	Group	*Skewness*	*Std. Error Skewness*	*Kurtosis*	*Std. Error Kurtosis*	*N*
Reading Comprehension	Control	-.742	.311	-.546	613	59.0
	Treatment	-1.080	.293	-.572	.578	67.0
Attitude Toward Computers	Control	-.861	.311	-.169	.613	59.0
	Treatment	-.558	.293	-.067	.578	67.0
Attitude Toward School	Control	-.482	.311	-.089	.613	59.0
	Treatment	-.662	.293	-.318	.578	67.0

Table 17

Pretest Descriptive Statistics for ANOVA for Each Group and All Variables

	Group	*Mean*	*Std. Error Mean*	*SD*	*Variance*	*Range*	*N*
Reading	Control	14.3279	.53673	4.12268	16.996	15.0	59.0
Comprehension	Treatment	14.7015	.53083	4.34502	18.879	19.0	67.0
Attitude Toward	Control	34.5254	.53861	4.13712	17.116	15.0	59.0
Computers	Treatment	36.8955	.58634	4.79941	23.034	18.0	67.0
Attitude Toward	Control	10.7119	.44384	3.40917	11.622	15.0	59.0
School	Treatment	11.1642	.40941	3.35115	11.230	12.0	67.0

Treatment

The treatment took place over a ten-week period between October and December of 2012. The researcher set a goal of 900 minutes of time on task for each student over the ten-week period. Actual time was closer to 500 minutes per student for the ten-week period, with a maximum time for any one student of only 600 minutes. The treatment took place in the classroom using clusters of computers or in computer labs using full group instruction. Students progressed through the application at their own pace. Destination Reading has three academic levels. Level 1 is for grades K-1, Level 2 is for grades 2-3, and Level 3 is for grades 4-5. The researcher met with each classroom teacher to discuss the best grade level for each student to begin the treatment at. Most students began at the same level of the program (Level 2) in October, but some began at Level 1 and some began at Level 3, based on teacher input. Most Level 1 students moved to Level 2, and some Level 2 students moved to Level 3. No students completed Level 3. Students who completed a Level moved on to the next level. No students ran out of assigned work in the program.

Minimum time spent on task using the software was 54 minutes; however this student was an outlier. The second lowest time on task was 214 minutes. The longest amount of time on task was 654 minutes, almost 11 hours. Mean time on task was 485 minutes, just over 6 hours. During the treatment, students progressed at their own pace through the application. All but 7 of the students completed one level of the software and moved to another level (either from 1 to 2 or 2 to 3). During the treatment period the control group students received traditional ELA instruction with no intervention.

Research Questions

This study explored two specific questions:

1. Is there a significant difference in the reading comprehension, attitude toward computers, and attitude toward school of students who receive targeted ELA instruction using multimedia applications and those who receive targeted ELA instruction without multimedia applications?
2. What are the perceptions of students who use multimedia applications in school and show the greatest gain in reading comprehension after the study treatment period?

Research Question One

Research Question Description

Research Question One consisted of one independent variable (type of instruction) with two levels (treatment and control groups). There were three dependent variables (reading comprehension, attitude toward school, and attitude toward computers). Reading comprehension was measured by the NYS 2009 English Language Arts Exam Part 1(NYS ELA: New York State Testing Program, 2009). Both attitude variables were measured by the Young Children's Computer Inventory (YCCI: Knezek, 1992). All students were in the third grade at the time of the study and the mean age of all students was 7.8 years. A MANOVA was used to determine if there were any significant differences in the posttest mean scores between the two groups (treatment and control). A MANOVA is ideally suited for data analysis when there are multiple variables that are loosely correlated and one or more pretest scores are not equivalent. When this is the case the MANOVA allows for repeated sampling of the data, (as with multiple ANOVAs) but the significance level does not need to be

reduced with a Bonferoni correction. The MANOVA is a more powerful test than multiple ANOVAs as it accounts for the sum effect of the multiple variables as if they were one variable (Fausset, Rogers, & Fisk, 2009

Identification of Posttest Outliers

Outliers have the potential to adversely affect the accuracy of the results of a MANOVA procedure (Meyers, et al., 2006). Researchers must carefully analyze the data present and determine if the outliers are in fact normal scores to be expected or are abnormalities that should be deleted. In this research five outliers were deleted after identification and investigation. All outliers were below the first quartile of scores identified in the box and whisker graphs. All outliers were in the treatment group and all were all at the low end of the score range. There were no outliers at the top of the scale and none of the outlier scores were assigned to ELL or special education students.

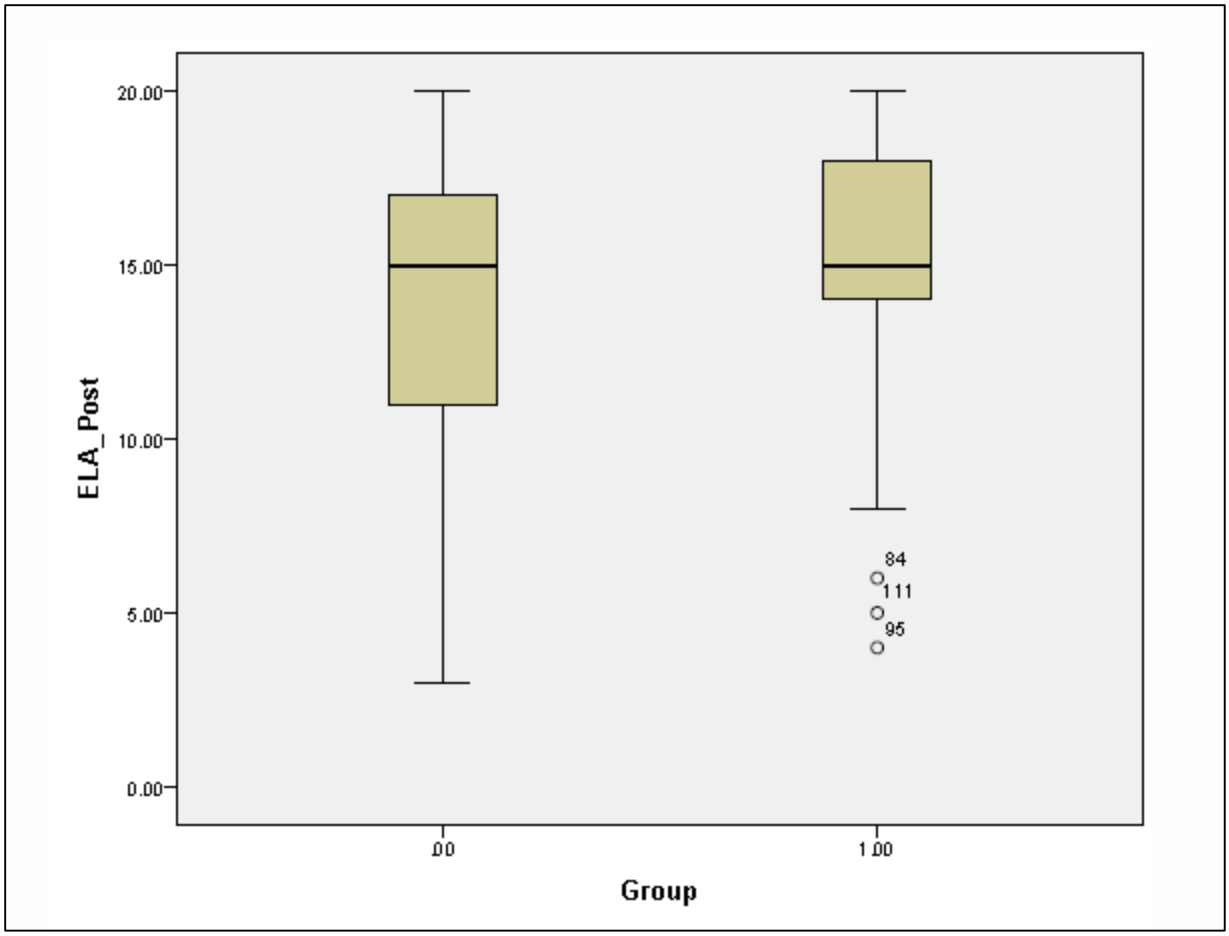

Figure 16. Box and Whisker Chart Depicting Scores for Control Group (0) and Treatment Group (1) on Posttest Reading Comprehension Measure Prior to Removal of Outliers.

For this variable, posttest score analysis revealed three outliers. These outliers were removed prior to the MANOVA procedure (Meyers et al., 2006) via listwise deletion.

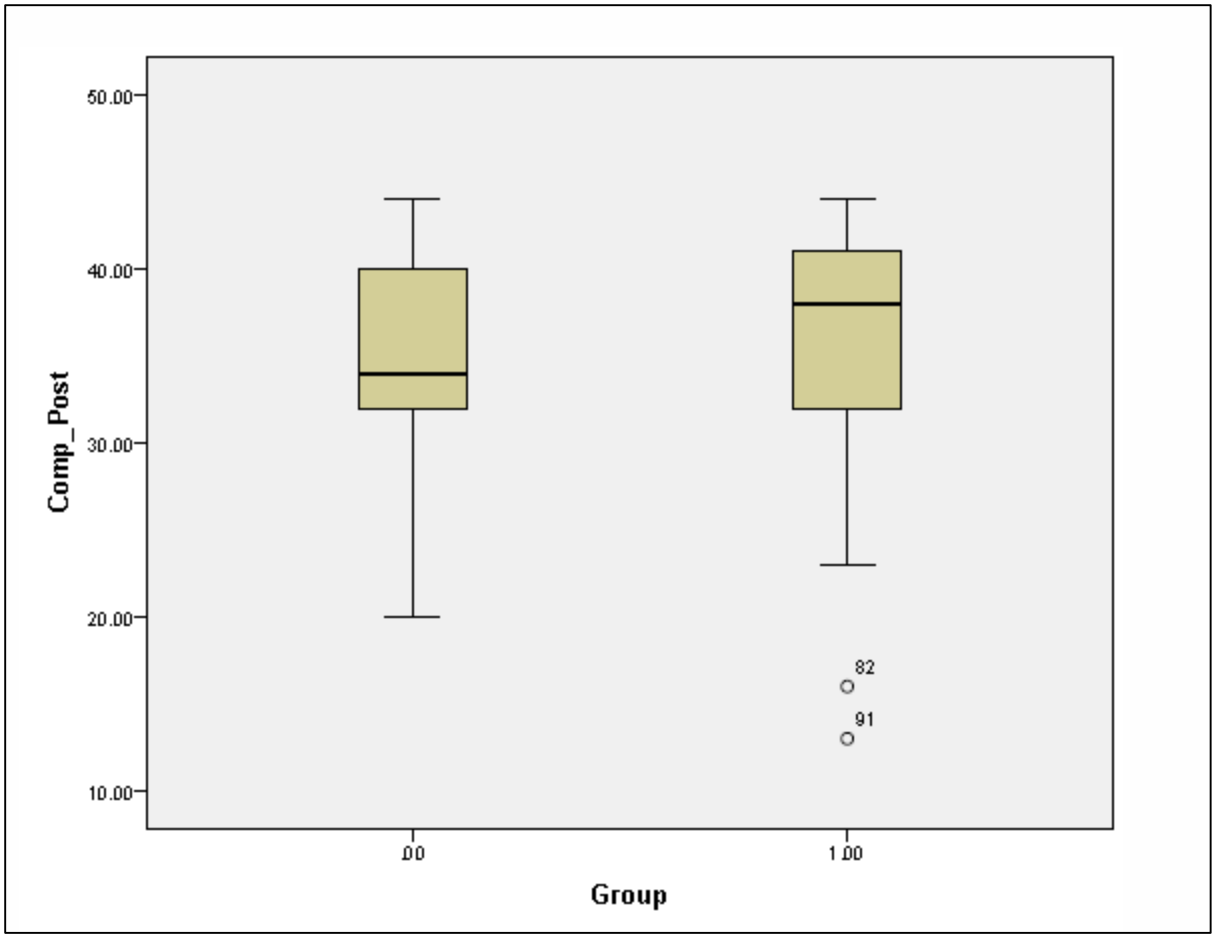

Figure 17. Box and Whisker Chart Depicting Scores for Control Group (0) and Treatment Group (1) on Posttest Attitude Toward Computers Measure Prior to Removal of Outliers. For this variable, posttest score analysis revealed two outliers. These outliers were removed prior to the MANOVA procedure (Meyers et al., 2006) via listwise deletion.

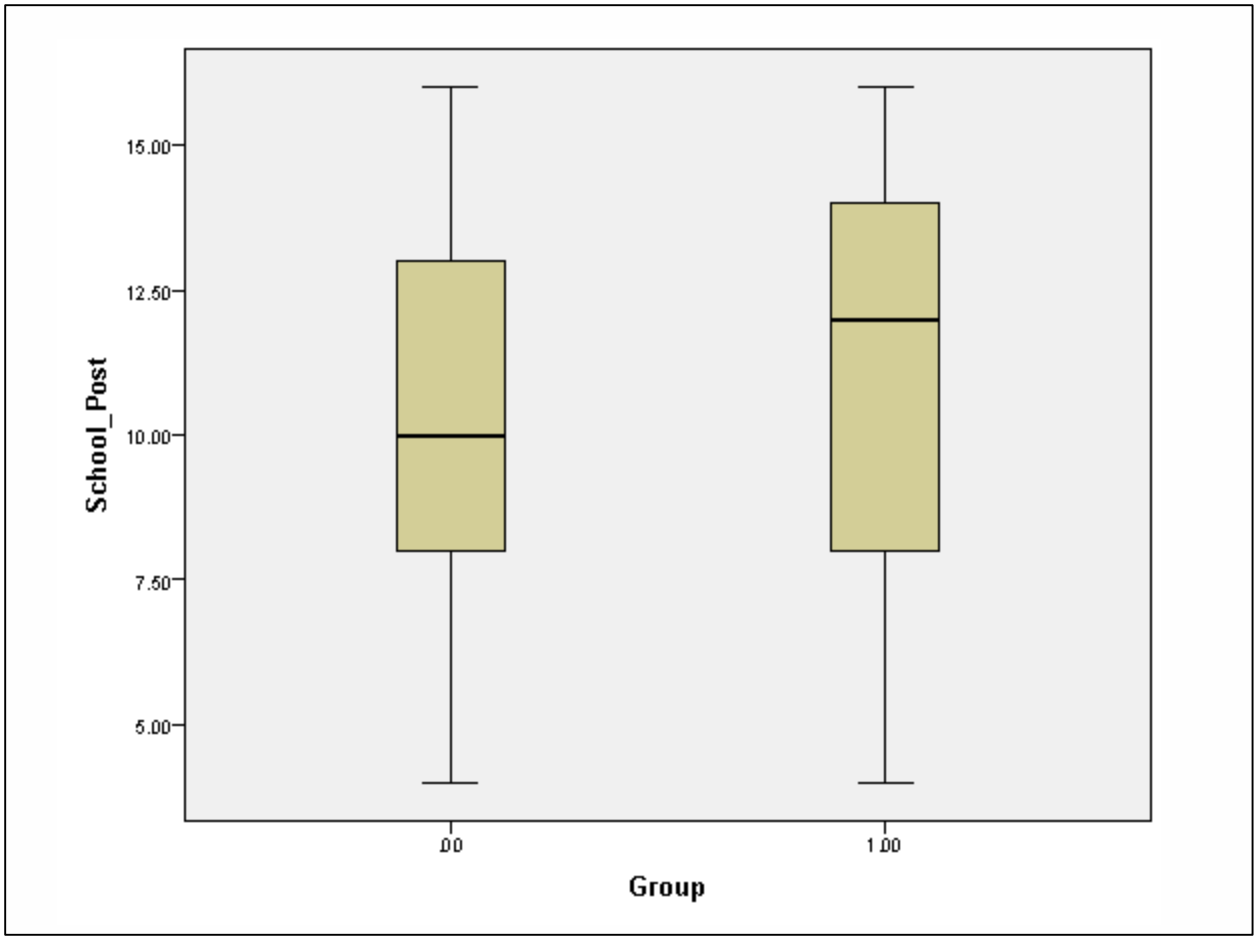

Figure 18. Box and Whisker Chart Depicting Scores for Control Group (0) and Treatment Group (1) on Posttest Attitude Toward School Measure Prior to Removal of Outliers.

For this variable, posttest score analysis revealed no outliers.

Assumption of Normalcy of Posttest Data

An assumption of Normalcy was made based on the skewness and kurtosis values displayed in Table 9 (Meyers et al., 2006). All values fell between -1.0 and +1.0, indicating that these data were neither too peaked nor too asymmetrical, although all variables were somewhat negatively skewed. In addition, data were plotted using a histogram function of SPSS with a normal curve overlay to visually verify normalcy of the data (Meyers et al., 2006). Figures 19-21 show the distribution of scores for each dependent variable in each

group. Finally, all skewness values calculated by SPSS are less than twice the standard error of skewness, thus indicating that skewness values fell within recommended normal limits (Meyers et al., 2006).

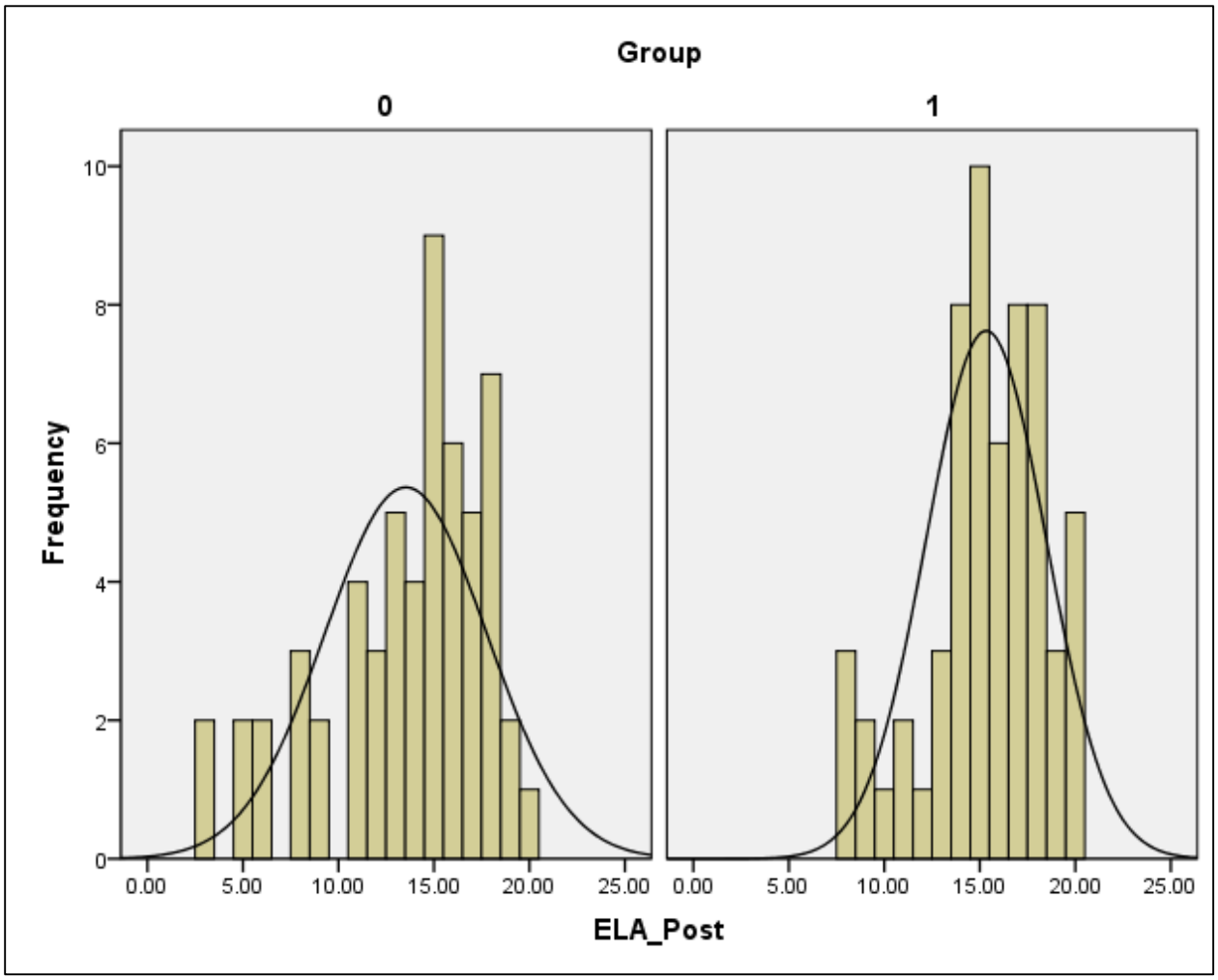

Figure 19. Posttest Histogram of Reading Comprehension Scores for Control Group (0) and Treatment Group (1)

The figure depicted all scores within the normal range. All skewness and kurtosis values were between -1.0 and + 1.0 and thus the distribution was deemed normal.

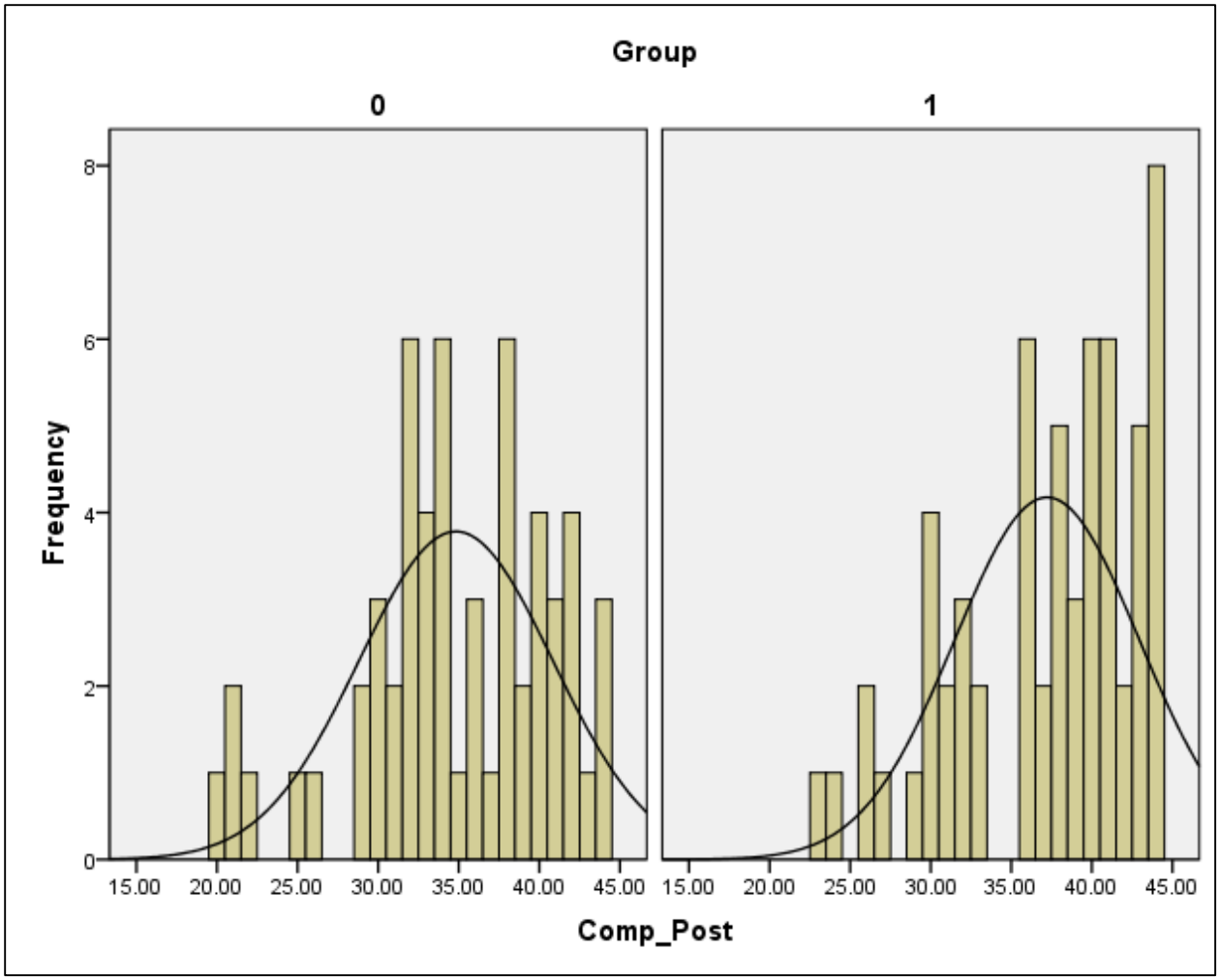

Figure 20. Posttest Histogram of Attitude Toward Computers Scores for Control Group (0) and Treatment Group (1)

The figure depicted all scores within the normal range. All skewness and kurtosis values were between -1.0 and + 1.0 and thus the distribution was deemed normal.

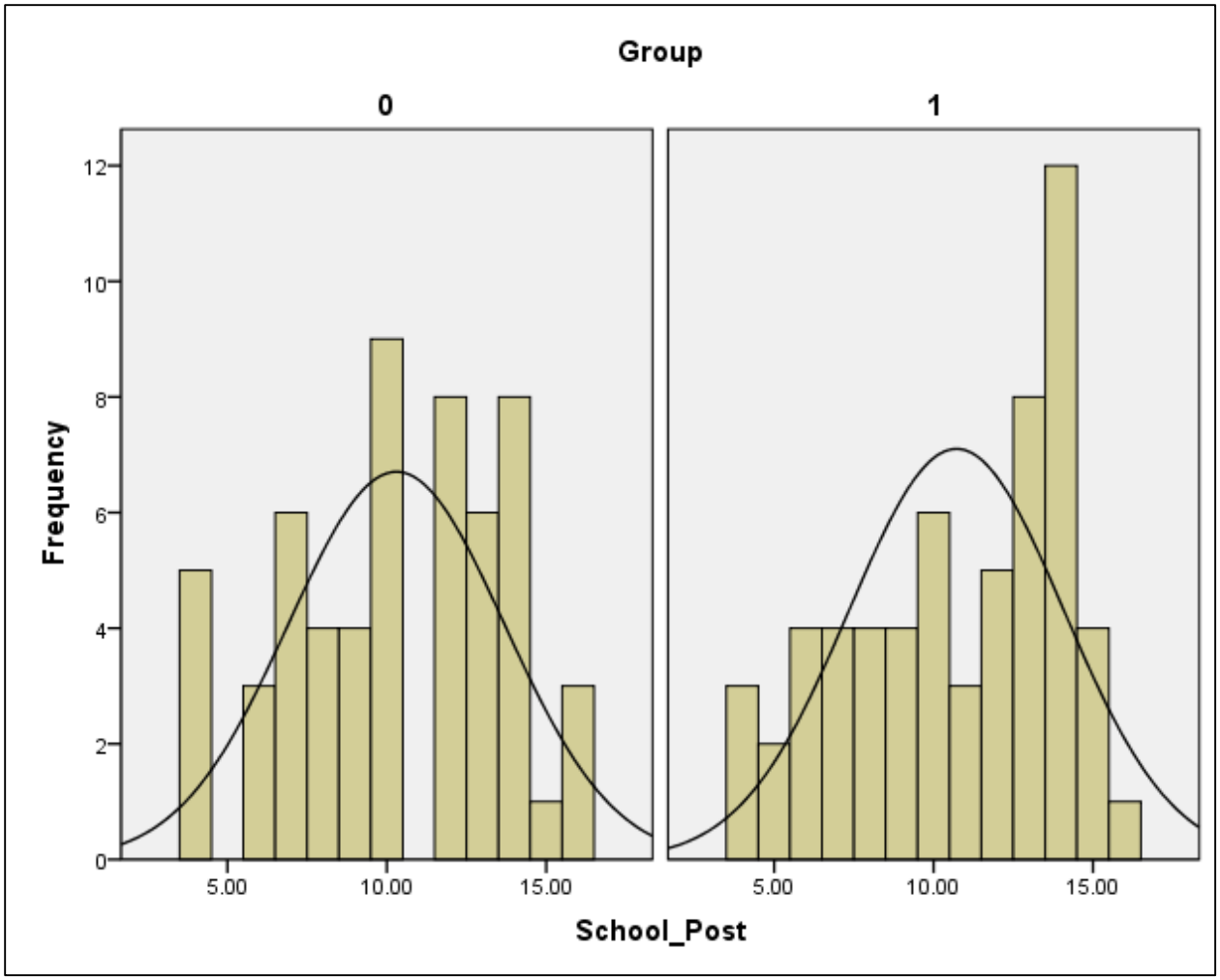

Figure 21. Posttest Histogram of Attitude Toward School Scores for Control Group (0) and Treatment Group (1)

The figure depicted all scores within the normal range. All skewness and kurtosis values were between -1.0 and + 1.0 and thus the distribution was deemed normal.

Assumption of Homogeneity of the Variance-Covariance Matrices

One necessary assumption required to implement a MANOVA is that sample sizes are not disparate and that variances and covariance are within acceptable ranges (Green & Salkind, 2008) for each variable in each group. The Box's M can be used to compute the significance of the equality of covariance. Box's M was calculated on the data using SPSSS and the results were not significant, $p = .075$. Therefore, the assumption of homogeneity was met, and the variance values between treatment and control groups for each variable were not significantly different, thus supporting the use of the MANOVA procedure.

Table 18

Box's M Computation on Posttest Data

	Box's Test of Equality of Covariance Matrices
Box's M	11.816
F	1.914
Df1	6.000
Sf2	9.5124.318
Sig.	.075

Assumption of Independence

Given the design of this study, the assumption of independence was partially met by the fact that students were in separate, discreet classrooms. Full independence cannot be ensured in a quasi-experimental study.

Code and Value Cleaning

All students were tested using a paper-based instrument. Tests were manually scored, with a single numerical value calculated for each variable. Reading comprehension was on a scale of 0-20, with 1 point for each correct item on a 20 question multiple choice instrument. Attitude toward computers was on a scale of 11-44, with 11 questions that could receive from 1-4 points each. Attitude toward school was on a scale of 4-16, with 4 questions that could receive from 1-4 points each. Data were entered into a spreadsheet application for sorting and visual inspection and preliminary analysis with regards to legitimacy and reasonableness. Skewness and kurtosis were examined and determined to be within the normal limits of -1.0 to + 1.0 (Meyers et al., 2006). In addition, scatter plots of all data were created. These plots confirmed that all data were within normal limits. Only outlier scores were deleted.

Descriptive Statistics

Descriptive statistics were produced for all posttest data and are displayed in Table 19. Pretest sample size was 126 students. When the posttest was implemented four students were absent or had moved out of the district, resulting in an adjusted posttest sample size of 122 students. After the removal of five outliers, the final posttest sample size was 117 students. This was slightly under the 20 to 1 ratio of cases to independent variables recommend by Meyers et al. (2006). Tables 19 and 20 display the differences in the descriptive data before the removal of five outliers (Table 19) with the data after the removal of five outliers (Table 20). Nine cases were deleted in total before posttest MANOVA data analysis was completed.

Table 19

Posttest Descriptive Statistics for Both Groups and All Variables Before Removal of Outliers

	Reading Comprehension	Attitude Toward Computers	Attitude Toward School
N	122.00000	122.00000	122.00000
Mean	14.26230	365.69670	10.54920
Std. Error of Mean	.364720	.58834	.30864
Median	15.00000	37.00000	11.00000
Mode	15.00000	38.00000	14.00000
Std. Deviation	4.02842	6.49843	3.40904
Variance	16.22800	42.23000	11.62200
Skewness	-.97400	-.95000	-.38500
Std. Error of Skewness	.21900	.21900	.21900
Kurtosis	.41200	.84300	-.95400
Std. Error of Kurtosis	.43500	.43500	.43500
Range	17.00000	31.00000	12.00000
Minimum	3.00000	13.00000	1.00000
Maximum	20.00000	44.00000	16.00000

Table 20

Posttest Descriptive Statistics for Both Groups and All Variables After Removal of Outliers

	Reading Comprehension	Attitude Toward Computers	Attitude Toward School
N	117.00000	117.00000	117.00000
Mean	14.45300	36.05130	10.51280
Std. Error of Mean	.35214	.55162	.31177
Median	15.00000	37.00000	11.00000
Mode	15.00000	38.00000	14.00000
Std. Deviation	3.80901	5.96664	3.37234
Variance	14.50900	35.60100	11.37300
Skewness	-.97700	-.66300	-.35700
Std. Error of Skewness	.22400	.22400	.22400
Kurtosis	.66300	-.16700	-.95700
Std. Error of Kurtosis	.44400	.44400	.44400
Range	17.00000	24.00000	12.00000
Minimum	3.00000	20.000	4.00000
Maximum	20.00000	44.00000	16.00000
Sum	1691.00000	4218.00000	1230.00000

Frequency Tables

Frequency tables display the concentration of scores across the range of all possible scores for each variable. Each table lists the score value, number of instances of that score,

and the percent of total scores assigned to each specific value. Tables 21-23 show the frequency of all scores for all variables after data cleaning. Outliers and scores removed by listwise deletion are not displayed.

Table 21

Frequency Table for ELA Exam Posttest Data for Reading Comprehension

Value	Frequency	Percent	Valid Percent	Cumulative Percent
3.00	2.0	1.7	1.7	1.7
5.00	2.0	1.7	1.7	3.4
6.00	2.0	1.7	1.7	5.1
8.00	6.0	5.1	5.1	10.3
9.00	4.0	3.4	3.4	13.7
10.00	1.0	.9	.9	14.5
11.00	6.0	5.1	5.1	19.7
12.00	4.0	3.4	3.4	23.1
13.00	8.0	6.8	6.8	29.9
14.00	12.0	10.3	10.3	40.2
15.00	19.0	16.2	16.2	56.4
16.00	12.0	10.3	10.3	66.7
17.00	13.0	11.1	11.1	77.8

Table 21 (continued)

Frequency Table for ELA Exam Posttest Data for Reading Comprehension

Value	Frequency	Percent	Valid Percent	Cumulative Percent
18.00	15.0	12.8	12.8	90.6
19.00	5.0	4.3	4.3	94.9
20.00	6.0	5.1	5.1	100.0
Total	117.0	100.0	100.0	

Table 22

Frequency Table for YCCI Exam Posttest Data for Attitude Toward School

Value	Frequency	Percent	Valid Percent	Cumulative Percent
4.00	8.0	6.8	6.8	6.8
5.00	2.0	1.7	1.7	8.5
6.00	7.0	6.0	6.0	14.5
7.00	10.0	8.5	8.5	23.1
8.00	8.0	6.8	6.8	29.9
9.00	8.0	6.8	6.8	36.8
10.00	15.0	12.8	12.8	49.6
11.00	3.0	2.6	2.6	52.1
12.00	13.0	11.1	11.1	63.2
13.00	14.0	12.0	12.0	75.2
14.00	20.0	17.1	17.1	92.3

Table 22 (continued)

Frequency Table for YCCI Exam Posttest Data for Attitude Toward School

Value	Frequency	Percent	Valid Percent	Cumulative Percent
15.00	5.0	4.3	4.3	96.6
16.00	4.0	3.4	3.4	100.0
Total	117	100.0	100.0	

Table 23

Frequency Table for YCCI Exam Posttest Data for Attitude Toward Computers

Value	Frequency	Percent	Valid Percent	Cumulative Percent
20.00	1.0	.9	.9	.9
21.00	2.0	1.7	1.7	2.6
22.00	1.0	.9	.9	3.4
23.00	1.0	.9	.9	4.3
24.00	1.0	.9	.9	5.1
25.00	1.0	.9	.9	6.0
26.00	3.0	2.6	2.6	8.5
27.00	1.0	.9	.9	9.4
29.00	3.0	2.6	2.6	12.0
30.00	7.0	6.0	6.0	17.9
31.00	4.0	3.4	3.4	21.4
32.00	9.0	7.7	7.7	29.1

Table 23 (continued)

Frequency Table for YCCI Exam Posttest Data for Attitude Toward Computers

Value	Frequency	Percent	Valid Percent	Cumulative Percent
33.00	6.0	5.1	5.1	34.2
34.00	6.0	5.1	5.1	39.3
35.00	1.0	.9	.9	40.2
36.00	9.0	7.7	7.7	47.9
37.00	3.0	2.6	2.6	50.4
38.00	11.0	9.4	9.4	59.8
39.00	5.0	4.3	4.3	64.1
40.00	10.0	8.5	8.5	72.6
41.00	9.0	7.7	7.7	80.3
42.00	6.0	5.1	5.1	85.5
43.00	6.0	5.1	5.1	90.6
44.00	11.0	9.4	9.4	100.0
Total	117.0	100.0	100.0	

Comparison of Treatment and Control Group Scores

Treatment and control group scores were compared for all three dependent variables using descriptive statistics for each group using box and whisker charts. Analysis of charts and data indicate that the treatment groups mean scores were higher for the variables reading comprehension, attitude toward school, and attitude toward computers. All scores are available for review in Appendix J. Table 22 depicted descriptive statistics for all variables

and both groups. Analysis of these data verified that the skewness and kurtosis levels were within acceptable limits for each variable within each group. Specifically, all skewness and kurtosis values were within -1 and +1.

Table 24

Posttest Descriptive Statistics for Each Group and All Variables

Variable	Group	*Mean*	*SD*	*Skewness*	*Kurtosis*	*N*
Reading	Control	13.5263	4.23887	-.884	.078	57.0
Comprehension	Treatment	15.3333	3.13897	-.711	.132	60.0
Attitude	Control	34.8246	6.01226	-.625	.078	57.0
Toward School	Treatment	37.2167	5.73154	-.749	-.370	60.0
Attitude	Control	10.2982	3.39098	-.255	-.872	57.0
Toward School	Treatment	10.7167	3.37032	-.466	-.979	60.0

MANOVA Results

A significance level above .05 on *Wilks' λ* would have indicated that the scores of the treatment group were not significantly higher than those of the control group. A MANOVA was conducted to compare posttest scores of students in the control and treatment groups on the variables reading comprehension , attitude toward school, and attitude toward computers. The MANOVA data revealed that the multivariate score of the treatment group was significantly higher than that of the control group, *Wilks' λ* = .919, $F(3,113) = 3.313$, $p = .025$, partial eta squared = .081. This partial eta figure indicated that approximately 8.1% of the variance in the composite dependent variable (reading comprehension, attitude toward

computers, and attitude toward school), was due to the independent variable (type of instruction). Effect size for these data was small.

Table 25

Multivariate Test Comparing Treatment and Comparison Posttest Groups for Reading Comprehension, Attitude Toward Computers and Attitude Toward School Scores

	MANOVA					
	Value	*F*	*Hypothesis df*	*Error df*	*Sig.*	*Partial eta squared*
Wilks' lambda	.919	3.313	3.00	113.00	.025	.081

Univariate ANOVA Results

Univariate ANOVAs were conducted on each dependent measure separately to determine the locus of the statistically significant multivariate effect. The analysis revealed that for the variable reading comprehension, there was a significant difference between the treatment and control groups $F(1,115) = 6.914$, $p = .010$, *partial eta squared* = .057, small. For the variable attitude toward computers there was a significant difference between treatment and control groups $F(1,115) = 4.854$, $p = .030$, *partial eta squared* = .041, small, with the treatment group scoring significantly higher on mean attitude toward computer scores. For the variable attitude toward school, there was no significant difference between treatment and control groups $F(1,115) = .448$, $p = .505$, with the treatment group and the control group showing no significant difference on mean attitude toward school scores.

Table 26

Univariate ANOVA Comparing Treatment and Control Posttest Groups for Each Variable

ANOVA						
Between Groups	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*	*Partial eta Squared*
Reading Comprehension	95.448	1	95.448	6.914	.010	.057
Attitude Toward Computers	167.263	1	167.263	4.854	.030	.041
Attitude Toward School	5.118	1	5.118	.448	.505	.004

Table 27

Mean Scores for Each Variable by Group

Group	Reading Comprehension	Attitude Toward Computers	Attitude Toward School
Control	13.526	34.825	10.298
Treatment	15.333	37.217	10.717

Research Question One Summary

Research Question One was used to explore whether or not there was a significant difference in the reading comprehension, attitude toward computers, and attitude toward school of students who received targeted ELA instruction using multimedia applications and those who received targeted ELA instruction without multimedia applications. A sample of 126 students was divided into a treatment and a control group. Each group received the NYS ELA and YCCI exams as pretests and an ANOVA was carried out on each variable to determine group equivalency. Two groups were equivalent, with no significant differences between treatment and control groups on the variables reading comprehension and attitude toward school. The variable attitude toward computers showed a small but significant difference between pretest scores.

The treatment group then received 10 weeks of targeted ELA instruction using multimedia applications. The control group received traditional ELA instruction in the classroom without multimedia applications. After the treatment period ended, all students were assessed using the NYS ELA exam and the YCCI instrument in order to determine the effect of the treatment. Prior to conducting the MANOVA, box and whisker graphs were produced to investigate the presence of statistical outliers. Statistical outliers are of concern when using a MANOVA as they may lead to inflated Type I error rates and produce erroneous reports (Meyers, Gamst, & Guarino, 2006). Five outliers were identified in the data. All five outliers were the lowest scores in the range of answers. Two were present in the NYS ELA reading comprehension scores, and three were present in the YCCI attitude toward school scores. Outliers were deleted from the data using listwise deletion. All data were determined to be within normal parameters for skewness and kurtosis.

A MANOVA was calculated after the removal of outliers and missing cases. The analysis revealed that the treatment group scored significantly higher than the control group, *Wilks'* $\lambda = .919$, $F(3,113) = 3.313$, $p = .025$, partial eta squared = .081. Effect size for this interaction was small. Univariate ANOVA analysis on each variable revealed that for the variable attitude toward school, treatment group mean scores were not significantly higher than those of the control group, while for the variables attitude toward computers and reading comprehension, there was a significant difference between mean scores for the treatment and control groups, with the treatment group scoring significantly higher than the control group.

Research Question Two

Qualitative Approach

A phenomenographic approach was taken in the collection and analysis of data related to Research Question Two. Phenomenographic analysis involves considering how individuals experience a phenomenon from the perspective of the experiencer; in this case, the student. It is well suited for an examination of the way in which students perceive their learning and change their behavior as a result of specific instruction (Gall, Gall, & Borg, 2007). In this case the phenomenographic approach was used to develop questions and analyze responses from the students.

One key aspect of phenomenographic research was that the researcher valued the perception of the subject above the researcher's own perception. The researcher posed questions that helped the subjects clearly state how they were affected by the instruction (Ornek, 2008). The goal of this portion of the research was to obtain an accurate picture of each subject's perception of the treatment, free of researcher biases. In addition, the phenomenographic approach was designed to depict the variance between the subject's

experiences of a learning situation (Dortins, 2002). By analyzing the interview transcripts clinically, the researcher was able to find patterns and themes in the text. The researcher discovered a consistent pattern amongst the subject's responses to the questions.

Identification of Interviewees

This research question addressed the affective domain through the following question: What are the perceptions of students who use multimedia applications in school and show the greatest gain in reading comprehension after the study treatment period? To address this question the researcher identified one student from each treatment class using purposeful sampling (Creswell & Plano Clark, 2011). Purposeful sampling is used to develop a broader understanding of the quantitative data. In this research the purposeful sampling protocol was used to identify students who showed the greatest gain in reading comprehension, a key focus of the study, and to elucidate details from the students about the treatment. The sample was selected to best address the research question. This selection was made based on quantitative data results. Specifically, it was posited that the students who showed the greatest quantitative gain on the comprehension measure would be able to describe the process of the treatment protocol and how it affected them.

Using a spreadsheet application, calculations of score growth were carried out on pretest and posttest scores to produce a net change in the reading comprehension score for each student. Scores in this column were sorted by size and class, and the student with the largest net gain in reading comprehension score for each class was selected to be interviewed. This process produced a list of five students. The researcher contacted each teacher to arrange an appointment to interview each student in a private setting. All interviews took place within the same week. Students assented to the interview and the

interviews were recorded using a digital voice recorder in the first week of January, 2013, and transcribed for analysis. The use of five students was deemed appropriate to meet the objectives of the qualitative portion of the research (Creswell & Plano Clark, 2011) given the sample size of 117 students. Three of the interview students were female and two were male.

Table 28

Calculation of Student Scores with the Largest Change

	NYS ELA Reading Comprehension Scores		
Student	Pretest	Posttest	Change
1	13	16	+3
2	16	18	+2
3	7	14	+7
4	15	20	+5
5	5	14	+9

Interview Protocol

A scripted, semi-structured interview was used to address the same questions (see Appendix J) with each student, with an option of asking follow up questions as needed. At least five questions were asked of each student. All interviews took place in a school office or empty classroom in the student's school during the regular school day, and were recorded using a portable digital voice recorder. Audio files were manually transcribed into a word processing program and then input into software for analysis (see Appendix K)

Qualitative Analysis Procedure

The qualitative research package HyperRESEARCH was used to analyze the interview text. HyperRESEARCH (HyperRESEARCH, 2012) is a software package used to facilitate analysis in qualitative research. It allowed the researcher to quickly identify codes and then themes using drag-and-drop tools to facilitate the process. The process involved importing the transcribed text of each interview into the software and searching for repetitive key words, between and within student data sets. As these key words emerged, each was coded and then assigned to a single theme. Each code was grouped into similar themes, and three themes emerged. Each theme word is linked to all other appearances of the theme, within and between cases, thus allowing for identification of patterns using visual analysis. The themes were used to best ascertain the true intent of each interviewee and minimize researcher bias.

Table 29

Samples of Qualitative Coding of Interview Transcripts

Theme		
Having Fun	Learning Content	Expressing Emotions
It was really, really fun	I learned a lot	I feel good
I like it so much and that was all new	It tells you about a lot of interesting things like space	I feel different
I liked everything, it was fun	It tells you a lot of things about the things	It changed the way I feel in a good way
I enjoyed it	It tells you some things	I feel amazing
Yes it was fun	It made me realize school is a good way to have you learn	I feel perfect now
I liked that a lot	I felt like I was learning	Interesting…yes

Qualitative Themes

The identification of themes in qualitative research is a valuable method of analysis (Gall, Gall, & Borg, 2007). Three themes emerged after the interview text was analyzed using HyperRESEARCH. Themes and codes were not pre-determined but emerged organically from the coding process.

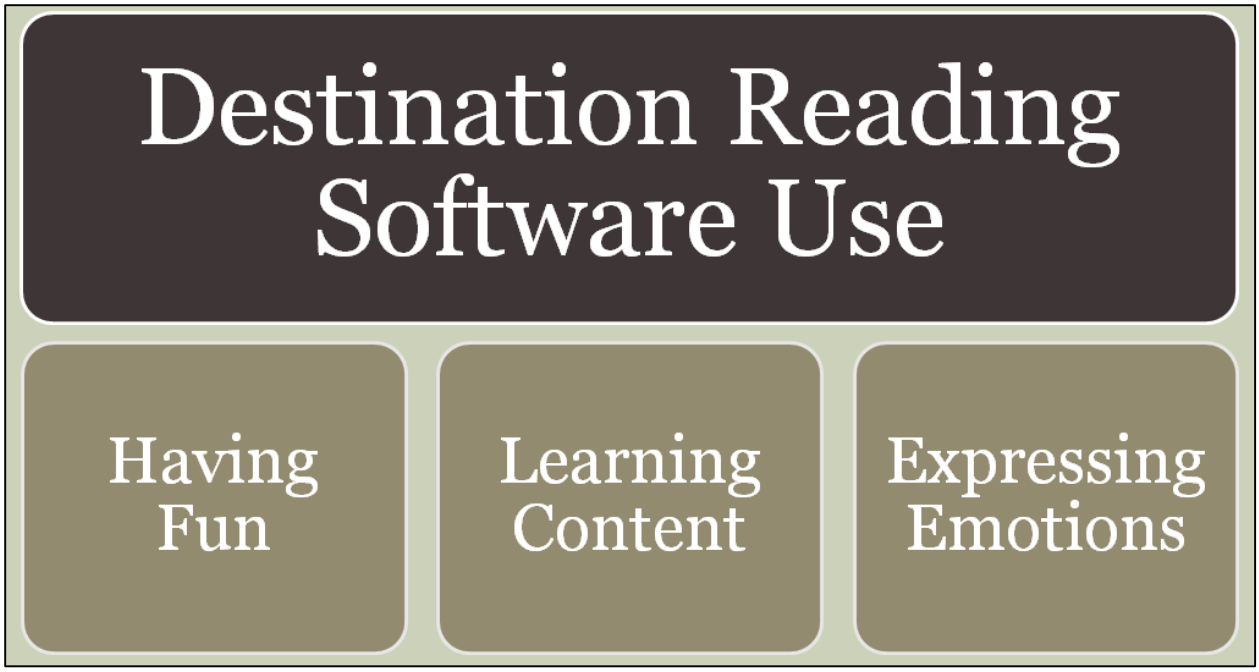

Figure 22. Depiction of Three Themes of Student Interview Responses.

The figure depicts the three themes that emerged from the qualitative analysis of the interviewee responses.

Forty-seven key words or phrases were identified, coded, and related to three themes that were identified and were focused on during the interview analysis. The frequency of appearance of words or phrases assigned to each theme was noted in Table 30. Table 31 defines and provides examples of each theme.

Table 30

Frequency of Interviewee Addressing Specific Themes in Interview Transcripts

	Case Number					
	1	2	3	4	5	Sum
Having Fun	5	2	6	4	2	19
Learning Content	6	2	4	2	1	15
Expressing Emotions	2	3	5	2	1	13

Table 31

Qualitative Data Themes

Theme	Definition	Example
Having Fun	Gave details on the enjoyment of the software by students	And now it's turning out to be fun in school
Learning Content	Described how the software affected the student's learning	I learned a lot about science and about how to write better
Expressing Emotions	Explained how a student felt about the treatment	(It was) exciting

The first and most obvious theme to emerge was that of having fun with the software. In this case having fun refers to a positive, satisfying feeling of enjoyment from the student towards using the software. Without exception all students reported that they had fun using the software. This occurred multiple times and in response to multiple questions, and was

offered spontaneously as well. Students reported that using the software was "fun" and "like a game." They commented that "I like to use it," "it was really fun," and that it was "exciting." When questioned for further details the students typically had difficulty expanding on their initial comments. Most just reasserted that the software was fun and they liked it. Student responses referred to fun or enjoyment a total of 19 times in the 5 interviews. This may support the notion that when students direct their own learning, whether it is computer based or not, they enjoy it more than teacher-directed activities (Henry, Mashburn, & Konold, 2007). All 5 students clearly had fun using the software and were able to express this enjoyment verbally.

Student 1: "I like how it is and how they use the fun games and learning activities into one." "I really like using the games because there was this other level and I didn't get all the way through it I just would get started and it was really fun."

Student 2: Computer use was "exciting".

Student 3: "It was just amazing. I like it so much and that was all new, we've never been on that before, that kind." "Well it was really, really fun. I learned a lot. I loved just reading all of the passages, the books, and it tells you about a lot of interesting things like space and how Jupiter has I think a red dot on it."

Student 4: "No, it's interesting because you get to use Connect and Download and a lot of that stuff and I really like that."

Student 5: "I really like how you have to type stuff about the story."

There was a common description of enjoying the game-like nature of the software and finding it fun to use. All students were unequivocal in their ranking of the software as enjoyable and fun, and in their assertion that it was like a game.

The second theme to emerge was expressing emotions. Expressing emotions was defined as an elevated emotional state shared by the students regarding the use of the software. Students reported that they "feel good," "feel different," that the software was "exciting," "amazing," and "new." One student commented that the software "made me realize that school is a good way to have you learn," and another commented that "I feel perfect now." Given the age of the interviewees it is notable that they were able to articulate their feelings so well. The theme of expressing emotions was referenced 13 times by the 5 students. This is especially noteworthy given that we know that a positive feeling, or attachment to school, is an indicator of positive attitude toward school (Libbey, 2004). All students expressed feeling some emotions about the software use. All 13 comments can be characterized as positive emotional feelings directed at the school, teacher or the software.

Student 1: "I feel kind of the same and a little bit different. I like to use it and I also like school and how they teach too."

Student 2: It changed the way I feel "in a good way."

Student 3: "I feel perfect now. School is now like my favorite thing."

Student #4: "Well computers are good not only for games for school work, homework

and all that stuff."

Student 5: "Because it made me realize..."

The third theme to emerge was learning content. Learning content in this context is defined as the perception by students that they acquired new skills from the use of the software. All students reported a sense that they were learning content from the software. They commented that the software "refreshes my mind," "was helpful," that "I learned a lot," "I learned how to write better," and "it tells you a lot of things". Students made the

connection between the software use and learning content, and one acknowledged that it was fun and "good for school too." The theme of learning content was addressed 15 times in the 5 interviews.

Student 1: "I remember some stories about historical things and times in our life like one of them was about the first African American lady to fly into space. That was a biography."

Student 2: "Computers can also be used for work."

Student 3: "It told me…like…it made me do math…like use my brain harder to do math."

Student 4: "I like Destination Reading 3 because you can read; it tells you some things

about the things."

Student 5: "… learn instead of having you not learning anything."

Table 31 depicts all 47 key words or phrases and the assignment to each code. The table shows a consistent pattern amongst the five students in terms of specific words used (fun, like, new, exciting), as well as the age-appropriate manner of speaking. All of the students were somewhat reticent to be interviewed. In some cases, questions were asked two or three times or rephrased to elicit an answer. While some students were verbose, most were fairly succinct in their responses, although all were cooperative and friendly.

Table 32

Thematic Analysis of Interviewee Transcripts

Case	Theme	Text
1	Having fun	enjoyed it
1	Having fun	like connect the words like thoughtful with the ice
1	Having fun	liked everything
1	Having fun	new things
1	Having fun	yes it was fun
1	Expressing emotions	I felt like I was learning
1	Expressing emotions	it felt new
1	Learning content	like to help me read better
1	Learning content	liked the stories and then I had to answer questions
1	Learning content	learned a little
1	Learning content	made me smarter
1	Learning content	new thing
1	Learning content	stories helped me read
2	Having fun	exciting

Table 32 (continued)

Thematic Analysis of Interviewee Transcripts

Case	Theme	Text
2	Having fun	Fun
2	Expressing emotions	exciting
2	Expressing emotions	yes
2	Expressing emotions	yes, but in a good way
	Learning content	can also be used for work
2	Learning	learned
3	Having fun	I liked that a lot
3	Having fun	fun in school
3	Having fun	I enjoyed it
3	Having fun	I like it so much
3	Having fun	I loved just reading
3	Having fun	really, really fun
3	Expressing emotions	a lot
3	Expressing emotions	new
3	Expressing emotions	amazing
3	Expressing emotions	l am perfect now
3	Expressing emotions	a lot

Table 32 (continued)

Thematic Analysis of Interviewee Transcripts

Case	Theme	Text
3	Learning content	learned a lot about science and about how to
3	Learning content	all the writing parts that they told me about
		didn't experience like the…in space I didn't learn about all
3	Learning content	planets
		the passages, the books, and it tells you about a lot of
3	Learning content	interesting things
4	Having fun	also fun because you get to use tools
4	Having fun	I really like that
4	Having fun	it's fun
4	Having fun	so it's really fun
4	Expressing emotions	are good not only for games for school work, homework
4	Expressing emotions	interesting…yes interesting
4	Learning content	it tells you some things about
4	Learning content	tells you a lot of things about like the planets
5	Having fun	I really like how you have to type stuff about the story
5	Having fun	it was fun
		it made me realize that school is a good way to have you
5	Expressing emotions	learn
		good way to have you learn instead of having you not
5	Learning content	learning anything

Qualitative Validation

When completing a qualitative interview process it is important to validate the data to ensure that the researcher has accurately captured the intent of the interviewee (Creswell & Plano Clark, 2011). In this research two methods were used for qualitative validation. Once the interviews were transcribed, the researcher met with each student again and read back the transcript with the researcher's annotations to verify that that the interviewee's intent was captured. This member checking process was used to validate the data. In all cases the students verified the accuracy of the interview transcriptions and the conclusions drawn.

The second approach that was utilized was the use of an expert peer auditor. A teacher employed in the district where the research was completed served as the auditor and reviewed all transcripts, data analysis, and annotations. She replicated the assignment of codes and themes and produced similar results. She examined the five transcripts and identified the same three themes. Her audit indicated that the analysis was consistent and accurate and reflected the intent of each interviewee's comments, and she found no areas of concern with the qualitative analysis as presented in this report.

Data Triangulation

Triangulation can be used to determine if there is a correlation between quantitative and qualitative data in a mixed method study (Creswell & Plano Clark, 2011) such as this one. In this study, data was analyzed for the 5 students selected for interview based on their gain in reading comprehension scores. Of the 5 students, 4 were above the mean of all students on time spent using the software during the treatment. However, there appeared to be no correlation between attitude gain as measured by the YCCI and reading comprehension gain as measured by the NYS ELA exam.

Table 33

Triangulation of Attitude and ELA Scores

	Triangulation of Attitude and ELA Scores			
Student	Minutes of Treatment	ELA Gain	Attitude Toward Computers Gain	Attitude Toward School Gain
1	370	3	-4	-1
2	521	2	-3	-4
3	556	5	-3	2
4	520	7	1	-8
5	507	9	-4	0

Summary

Data were reviewed from two research questions in this chapter. Research question one determined if there was a significant difference in posttest scores measuring reading comprehension, attitude toward schools, and attitude toward computers, for students who participated in 10 weeks of instruction using online multimedia applications. A statistically significant difference was found between treatment and control group scores using a MANOVA after the removal of outliers. Students who received the treatment scored higher on the multivariate analysis of posttest scores. Univariate ANOVA scores of the treatment group on the variable attitude toward computers were higher than control group scores. Univariate ANOVA scores on the variable attitude toward school and reading comprehension were not statistically different between treatment and control groups. In addition, minimum scores for the treatment groups were higher for all three variables.

Qualitative analysis revealed three common themes that all students expressed in the interviews: having fun, learning content and expressing emotions. All students found the software to be fun, exciting and engaging, and had positive feelings about using it. They felt that it supported learning and school work, and enjoyed using the software and computers. These data supported the quantitative gains in reading comprehension scores achieved by all of the students.

Chapter Four presented an analysis of the data. An overview of the entire study, including implications for further research, is presented in Chapter Five.

CHAPTER 5: SUMMARY AND CONCLUSIONS

Computer use amongst students ages 8-18 has grown considerably over the past decade, and continues to increase (Kaiser Family Foundation, 2010). Not only are students using more computers, but they are accessing online content through portable devices such as smartphones, tablets, and laptops, both at home and at school. Teachers and administrators have sought to keep up with this trend and to make education more engaging through the use of a variety of online multimedia applications. Research suggests that, when properly designed and deployed, multimedia software can have a positive effect on student learning (Bialo & Sivin-Kachala, 1996). Multimedia applications can increase student engagement and interest in school and can contribute to academic achievement when properly deployed. Multimedia software that is student-directed, engaging, and related to the curriculum has been shown to contribute to positive student attitudes and increased student effort (Becker, 2000).

There is a large body of research supporting the notion of the effectiveness of multimedia software and explaining how it works on a cognitive level. Mayer's Cognitive Theory of Multimedia Learning outlines several principles that explain how visual and verbal information is received, processed, and interpreted (Mayer, 2002). This theory explains how multimedia learning environments are best designed to ensure maximum learning. Destination Reading (2007) used in this study, is a multimedia learning application.

This study examined the effect of the use of multimedia applications on three variables. A MANOVA was used to analyze scores on reading comprehension, attitude toward school, and attitude toward computers, of 117 third grade students in a medium-sized

suburban Mid-Atlantic school district. A semi-structured interview also was conducted with five students and qualitative analysis was carried out on these data.

The first quantitative variable, reading comprehension, is a measure of how well a reader is able to understand the content of written text and how effectively meaning is extracted from this text (National Reading Panel, 2003). Reading comprehension is a key aspect of education and is essential to overall literacy and success in other content areas (Henderson & Buskist, 2011). Reading comprehension was measured by the NYS ELA exam in this study.

The second quantitative variable, attitude toward school, is a measure of a student's sense of belonging and fulfillment in the school setting. It is a way of measuring how a student feels about school and the value the student places on academics. Positive attitude is correlated to aversion of high risk behaviors and can be a precursor of academic success (Jessor et al., 1995). Attitude toward school was measured by the YCCI instrument in this study.

The third quantitative variable, attitude toward computers, is a measure of an individual's sense of the importance of computers and feeling of enjoyment when using them (Knezek, Miyashhita & Sakamoto, 1996). Attitude toward computers can be measured via a variety of instruments and research indicates that increased computer use leads to increased positive attitude toward computers (Cavas, Cavas, Karaoglan, & Kisla, 2009). Attitude toward computers was measured by the YCCI instrument in this study.

Qualitative analysis revealed three themes in the transcripts: having fun, learning content, and expressing emotions. Students were consistent in expressing their enjoyment when using Destination Reading, and thought that the software helped them learn.

Enjoyment was a specific positive feeling that the software was pleasurable to use for the student. Students specifically mentioned that that the software helped them learn reading. They also commented that they learned about science from some of the passages in the units which were focused on scientific ideas. Emotions were expressed regarding the experience of the treatment, including excitement, amazement and a sense of novelty.

The study was based on the researcher's wish to better understand the effects of ELA multimedia software on student cognition and attitude. While research exists on this topic in general, the specifics of this study made it unique. There was little research on the effect of ELA software on reading comprehension in particular, and little recent research on the effect of this type of software use on student attitudes toward school and toward computers.

Summary of the Study

To address the research questions, a school district was selected, and approximately half of the grade 3 students in the district received 10 weeks of targeted ELA instruction using traditional teaching methods. The remainder of the students received a treatment which consisted of instruction using a specific multimedia application, Destination Reading (2007), for a portion of the time normally spent using the traditional, teacher-directed teaching methods. Destination Reading was used in the student's regular classroom and in school computer labs using online software on up-to-date computers with network and Internet access. Destination Reading (2007) is an interactive, web-based ELA multimedia application that offers instruction in reading comprehension, phonics, grammar, and writing. Students accessed the software in their regular classroom, in centers, and in a whole class setting in the computer lab at each school. The average time on task for each student was 8.08 hours per student for the treatment period of 10 weeks. Destination Reading (2007) was

chosen because it was age appropriate and the students in the sample had never used it before. In addition, the software was readily available in the school district where the research took place.

Students were selected from the entire population of 178 third grade students in the district. After permission slips were distributed and parental approval received, the sample was 126 students. This was reduced to 122 at the posttest due to missing data, and then to 117 after the removal of outliers, using listwise deletion in all cases. Two instruments were administered as pretest and posttest to all students who participated in the study. The NYS ELA (2009) exam measured reading comprehension, and the YCCI (Knezek, 1992) measured attitude toward computers and attitude toward school. Pretest ANOVA analysis indicated that treatment and control groups were equivalent on reading comprehension and attitude toward school but not on attitude toward computers. Posttest MANOVA indicated a significant difference in the composite dependent variate scores between treatment and control groups for the three dependent variables when considered together. In addition, five students were selected for semi-structured interviews. All five students were interviewed in their schools and the interviews were recorded, transcribed and analyzed using HyperRESEARCH (HyperRESEARCH, 2012), a qualitative analysis package.

Results and Findings

Research Question One

The first research question addressed the three dependent variables of the study, reading comprehension, attitude toward school, and attitude toward computers. Research Question One: Is there a significant difference in the reading comprehension, attitude toward computers, and attitude toward school of students who receive targeted ELA instruction

using multimedia applications and those who receive targeted ELA instruction without multimedia applications?

The directional hypothesis stated that students who received targeted ELA instruction using multimedia applications would score significantly higher on reading comprehension scores, significantly higher on measures of attitude toward computers, and significantly higher on measures of attitude toward school, when compared to those who received targeted ELA instruction without multimedia applications.

The MANOVA revealed that the treatment group scored significantly higher than the control group, *Wilks'* $\lambda = .919$, $F(3,113) = 3.313$, $p = .025$, partial eta squared = .081, on the composite dependent variate using the MANOVA. The students who received targeted ELA instruction using multimedia applications scored significantly higher than those who received targeted ELA instruction without multimedia applications. Effect size for this interaction was small. An analysis of univariate ANOVA data revealed that treatment group students scored significantly higher than control group students on the measure of attitude toward computers, $F(1,115) = 6.914$, $p = .010$. For the variable reading comprehension, there was a significant difference between treatment and control groups, $F(1,115) = 4.854$, $p = .030$. For the variable attitude toward school, there was no significant difference between treatment and control groups $F(1,115) = .448$, $p = .505$.

Research Question Two

Research Question Two: What are the perceptions of students who use multimedia applications in school and show the greatest gain in reading comprehension after the study treatment period? Five students were selected and interviewed for this research question. Students associated the software with having fun, learning content, and expressing emotions.

Students found the software enjoyable and felt it was a useful learning tool. Feelings toward the use of the software were positive overall, including a sense of excitement and amazement when using the software.

Comparison and Contrast of Findings

The literature presented in Chapter Two is largely supported by the outcome of this research. Research Question One addressed the results of the treatment in quantitative terms, while research Question Two did so with qualitative data. Both questions are related to the literature in the sections below.

Research Question One and the Literature

This section will address each variable in Research Question One in terms of the data presented in Chapter Four and the literature presented in Chapter Two.

The use of computer aided instruction has shown positive growth in reading achievement and reading comprehension. Soe and Chang (2000) determined a small effect size of 0.1316 in their meta-analysis and determined that CAI can increase reading achievement. Macaruso and Rodman (2011) showed that preschoolers and kindergarteners receiving computer aided instruction using a multimedia literacy application showed gains in literacy skills when compared to a control group. A similar study by Kulik and Kulik (1991) produced an effect size of 0.34, also small. The present research supports the results of these prior studies. MANOVA data revealed that the treatment group scored higher on a reading comprehension measure than the control group, with an effect size in the present study of .081, smaller than any cited by other researchers but still significant.

Knezek, Miyashhita and Sakamoto (1996) conducted research in Japan and the USA that supported the claim that increased exposure to computers increased positive attitude

towards computers. Geissler and Horridge (1993) also stated that increased computer use leads to increased positive attitude toward computers. In addition, computer use has been directly correlated to positive computer attitude (Levine & Donitsa-Schmidt, 1997), and this was borne out in the present study. The treatment group showed a significant difference in computer attitude scores as compared to the control group, due perhaps to the treatment and increased exposure to computers.

Henry, Mashburn and Konold (2007) stated that children much prefer computer games and self-directed activities over assigned homework and tests, and that increased exposure to computers can have a positive impact on attitude toward school. The present study does not support this finding. The students in the treatment group did not score significantly higher than those in the control group on the attitude toward school measure.

Research Question Two and the Literature

This section will address the question posed in in Research Question Two in terms of the data presented in Chapter Four and the literature review presented in Chapter Two.

The qualitative data supports the notion that students do enjoy using computers and self-directed software, and that this was a fun and learning experience for them. All five students interviewed expressed that they liked the treatment and found the software to be exciting and fun to use.

STUDENT #1: Like um. I felt like I was learning like a few new things.

STUDENT #1: I liked everything about it.

STUDENT #2: (It was) exciting.

STUDENT #3: Well it was really, really fun. I learned a lot.

STUDENT #3: It was just amazing. I like it so much and that was all new, we've never been on that before, that kind.

STUDENT #3: I feel perfect now. School is now like my favorite thing.

STUDENT #4: Well it's really…it's fun…

STUDENT #5: Because it made me realize that school is a good way to have you learn instead of having you not learning anything.

Research presented in Chapter Two (Henry, Mashburn & Konold, 2007) supports these qualitative results. Specifically, students who were exposed to the treatment and used the computers for the 10-week treatment period showed a positive feeling toward the program and enjoyed using it. While the level of detail provided by the interviewees was limited, they did disclose enough information to provide a sense that the experience of the treatment led to strong positive feelings overall and specific positive feelings about learning.

The research of Becker (2000) presented in Chapter Two indicated that computer activities that are independent, challenging, and stimulating lead to increased effort by students and a positive attitude overall. Destination Reading was used in this treatment because it was designed to be used independently by students, it is academically challenging, and the game-like interface is engaging for students. All students went through the program at their own pace, essentially allowing for a self-directed learning experience. The interview responses support Becker's research. Students reported a positive attitude and agreed that the game was fun and interesting to use.

One important criteria delineated in the Apple Classroom of Tomorrow (ACOT) research (Sandholtz et al., 1997) is that classroom computer use should be aligned to the curriculum, not used in isolation, in order to be effective. In the present study, the use of

Destination Reading was presented as an integrated part of the ELA program, and was used by teachers during their literacy block of instruction. Students were exposed to Destination Reading in context. This was an important factor in determining relevancy and level of interests in the ACOT study (Sandholtz et al., 1997). In the present study students reported a high level of interest in the software. These data appear to be supported by the research presented in Chapter Two.

Limitations

Teacher adherence to the researcher-defined treatment protocol was a major limitation of this study. The study proposal set forth a time frame of 90 minutes per week for each student in the treatment group over a period of 10 weeks. This was explained to the teachers as requiring three sessions per week for 30 minutes each session of student time on task. This would have allowed each student to accrue a total of 15 hours of software use over 10 weeks. For a variety of reasons this proved impossible to accomplish. The average time on task for each student was 8.1 hours. The maximum time on task for any single student was 10.9 hours and the minimum for any single student was 54 minutes. Several factors led to this shortfall, including a major hurricane that caused a week-long closure to schools in the area where the research took place, difficulty scheduling time in computer labs, and teacher's reluctance to give up instructional time in the year of a new high-stakes teacher evaluation system in the state where the research took place. These are all part of the reality of our education system and part of the inherent difficulty teacher's face when implementing any new instructional program; time is in short supply and in high demand for teachers today. It is not clear the results of the posttest would have been different if each student received closer to the planned 15 hours of instruction. However, it is worth noting that a small but

significant change was measured in scores on the multivariate variable and on two of three univariate variables after an average of only eight hours of instruction per student over 10 weeks. It is also worth noting that the treatment group had 12 specials education students while the control group had only four. This would seem to indicate that the software was just as effective with classified students as it was with regular education students.

The treatment portion of this study employed a quasi-experimental design, which had inherent limitations. Specifically, quasi-experimental designs do not include random assignment of individuals to group. It was thus difficult to ensure that only the independent variable affected the change in dependent variable (Kirk, 2013), which is the desired outcome. In this study, intact classes were selected randomly. With only 5 out of 10 classes selected as the treatment group, the behavior of any one or two teachers could have altered the results significantly.

Given that teachers had to bring their students to the computer lab, or assign them to use the computers in the classroom, teacher attitude and investment in the treatment had a profound impact on the outcome. With any treatment involving children it is essential that the adult participants are committed to the research. This was the case in the present study; however, as mentioned, the realities of life in a third grade classroom impinged on the best intentions of some teachers.

In addition to the total number of hours spent using the software, the overall duration of the entire treatment is worth noting. While Kulik and Kulik (1991) state that shorter treatment duration can be more effective, it is worth considering that there was limited access to the software in the 10-week period in this study. Had the treatment lasted longer perhaps the increased use of the software would have increased the effect size for the comprehension

and attitude toward computer variable scores, and made the attitude toward school variable scores significant. This extended treatment period may have compensated for the reduced time per week spent using the software.

Implications for Education

Educators today have come to rely on technology tools to help them manage many daily tasks in their classrooms. Teachers are quite familiar with using email, searching the web, doing word processing, using online grade books and report cards, and presenting lessons with various software packages. However, many teachers still remain reluctant to give up their role as chief content provider and to use CAI as an assistive tool. This research, and other research like it, demonstrated that CAI using online multimedia applications was an effective means of delivering ELA content and did improve reading comprehension and attitude toward computers. Further examination by school leaders and teachers is warranted. In particular, it is worth considering how schools can best leverage their already large investment in technology tools to deploy effective teaching and learning solutions. While many schools have well developed instructional technology programs, it is not common for schools to measure the effectiveness of their investments in terms of actual student learning. Parents and students have come to expect the availability of these tools for student collaboration, productivity and communication, but have not yet demanded that these tools demonstrate increased academic achievement for students. Schools should demonstrate this before it is required of them by their stakeholders.

The increased pressure on today's teacher is very real. Teachers are being asked to do more and more, with fewer resources and less time. CAI using ELA multimedia applications can be a valuable tool in the struggle to better educate our students. By using

high quality multimedia software and the power of the Internet educators could extend the school day and ensure that students have more time on task with approved educational content. This new paradigm could have profound effects on children and educators. Although this study specifically examined the use of ELA multimedia applications in lieu of traditional ELA instruction, many schools are struggling to extend the school day with minimal costs. Online multimedia applications may offer a cost-effective way to achieve this goal. If online multimedia instruction can effectively ensure learning, as this study indicates, then it is reasonable to assume that it can do so from home as well. Schools should actively investigate ways to deliver asynchronous instruction to students through applications like Destination Reading, blogs, wikis and teacher websites.

One final consideration is the process for deploying new initiatives in schools. Teacher morale is at its lowest level since 1989 (Markow & Pieters, 2012). With the increasing demands of the implementation of the Common Core Standards, evaluation requirements placed upon teachers by Race to the Top, and the economic realities of our era, it is no surprise that teachers feel under attack (Markow & Pieters, 2012). Add to this a wave of anti-union sentiment sweeping the country and teachers feel beleaguered and unappreciated (Markow & Pieters, 2012). In this climate it is extremely challenging to adopt new initiatives. This treatment was effective because it had widespread support, from the Superintendent of Schools, the Principals in each school, and the third grade teachers. Such support is essential for new initiatives to take root.

Suggestions for Future Research

Of most interest to this researcher is the question of the effect of increased time using the software. The research design called for 15 hours of time on task, over a period of 10

weeks. In reality, no student achieved this much time using the software. The maximum time spent over the 10 weeks was 10.9 hours. It would be worth studying the effect of 15 or 20 hours of student time on task over the same 10 week period. If the limitation of time on task of this study could be overcome another study would be warranted. Such a study would answer the question regarding duration of treatment. Specifically, if the teachers exercised better fidelity to the treatment plan, would the outcome have changed? It would be possible to know this for sure only with another study that provides for more treatment time on task using the software.

This study did not examine the effects of other content area software. Further studies should use the same protocol with different software, specifically math, to see if similar results are obtained. The rationale for this study states that results may be generalized to other content areas, but it would be worth examining this in closer detail with math in particular and perhaps with social studies or science software. Given the high priority placed on ELA and mathematics in schools today, this seems like a worthwhile endeavor.

Similar results on math, science, and social studies multimedia software would allow researchers to correlate the effects sizes of each treatment after co-varying for treatment time on task. This would answer the question about generalizability to other content areas.

Data in this study were available on race, gender, poverty level, language status, and special educations classification. These data were used to help select equivalent groups, but scores for students in each sub-group were not disaggregated. Such a process would have the potential to reveal important information about the efficacy of multimedia tools with each sub-group. Research was cited in Chapter Two showing differences between male and

female student outcomes, but no research regarding the differences between efficacies of multimedia tools for the other sub-groups was examined.

The impact of CAI on special education students in particular is of some interest. The subgroup sample in this study is too small to draw conclusions, but perhaps with a larger sample of classified students a similar study could provide information about the efficacy of multimedia learning for classified students.

One final area worth considering is the generalizability of this research protocol to other grade levels. It would be worthwhile to investigate if similar effects are obtained with grade five, eight, and 10 students. This information would be most useful to school leaders in informing their decisions regarding widespread implementation of software programs.

Conclusion

Educators and researchers have been enamored with the prospect of CAI for decades (Cuban, 2010). The idea of being able to increase academic achievement through the use of software applications has been discussed for years in academia (Cuban, 2010). Much research has been conducted on the efficacy of CAI in the school setting. As with any field of research, there are detractors and supporters of these data. The present study has shown how CAI was effective in improving reading comprehension. Small but significant gains were made in the reading comprehension skills of third grade students after an average of eight hours of use over a 10-week period. While the gains were minimal, there is good reason to believe that the use of this multimedia application, and others like it, can be an effective instructional tool.

The application used in this study, Destination Reading, appears to be designed with some attention given to the principals of the Cognitive Theory of Multimedia Learning

(CTML). Text is adjacent to images as per the Spatial Contiguity Principal, and student directions are narrated with animation rather than printed, as per the Modality Principal. The design principals of the CTML were evident in Destination Reading. In addition to the two Principals mentioned above, other examples were seen are indicative of a thoughtful multimedia design.

In this study instruction took place during the school day. It is worth considering what effect would have been seen if the students used the software in addition to their classroom instruction (i.e., from home) rather than in lieu of it. The promised advantage of CAI is that it enables the child to learn anywhere, anytime. Perhaps this research and research like it will speed the adoption of these tools in schools and homes, thus finally realizing the full benefit of instructional technology for children. Certainly children deserve to use every tool available to give them the best education possible.

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APPENDICES

Appendix A: YCCI Exam

(Reprinted and used with permission of the author)

Questions 1 and 2 are practice questions. Complete them with the teacher. Circle the best answer for you right now.

1. Ice cream is my favorite food.

NO MAYBE NO MAYBE YES YES

2. Ice cream is not my favorite food.

NO MAYBE NO MAYBE YES YES

Answer the remaining questions on your own. Take your time and circle the best answer for you right now.

3. I will be able to get a good job if I learn how to use a computer.

NO MAYBE NO MAYBE YES YES

4. I would work harder if I could use computers more often.

NO MAYBE NO MAYBE YES YES

5. I know that computers give me opportunities to learn many new things.

NO MAYBE NO MAYBE YES YES

6. I can learn many things when I use a computer.

NO MAYBE NO MAYBE YES YES

7. I believe that the more often teachers use computers, the more I will enjoy school.

NO MAYBE NO MAYBE YES YES

8. I believe that it is very important for me to learn how to use a computer.

NO MAYBE NO MAYBE YES YES

9. **I enjoy doing things on a computer.**

NO **MAYBE NO** **MAYBE YES** **YES**

10. **I am tired of using a computer.**

NO **MAYBE NO** **MAYBE YES** **YES**

11. **I concentrate on a computer when I use one.**

NO **MAYBE NO** **MAYBE YES** **YES**

12. **I enjoy computer games very much.**

NO **MAYBE NO** **MAYBE YES** **YES**

13. **I enjoy lessons on the computer.**

NO **MAYBE NO** **MAYBE YES** **YES**

14. **When I grow up I would not like to work in a school.**

NO **MAYBE NO** **MAYBE YES** **YES**

15. **I really like school.**

NO **MAYBE NO** **MAYBE YES** **YES**

16. **School is boring.**

NO **MAYBE NO** **MAYBE YES** **YES**

17. **I would like to work in a school when I grow up.**

NO **MAYBE NO** **MAYBE YES** **YES**

Appendix B: Destination Reading Screen Shots

Student Course Menu

Student Unit Menu

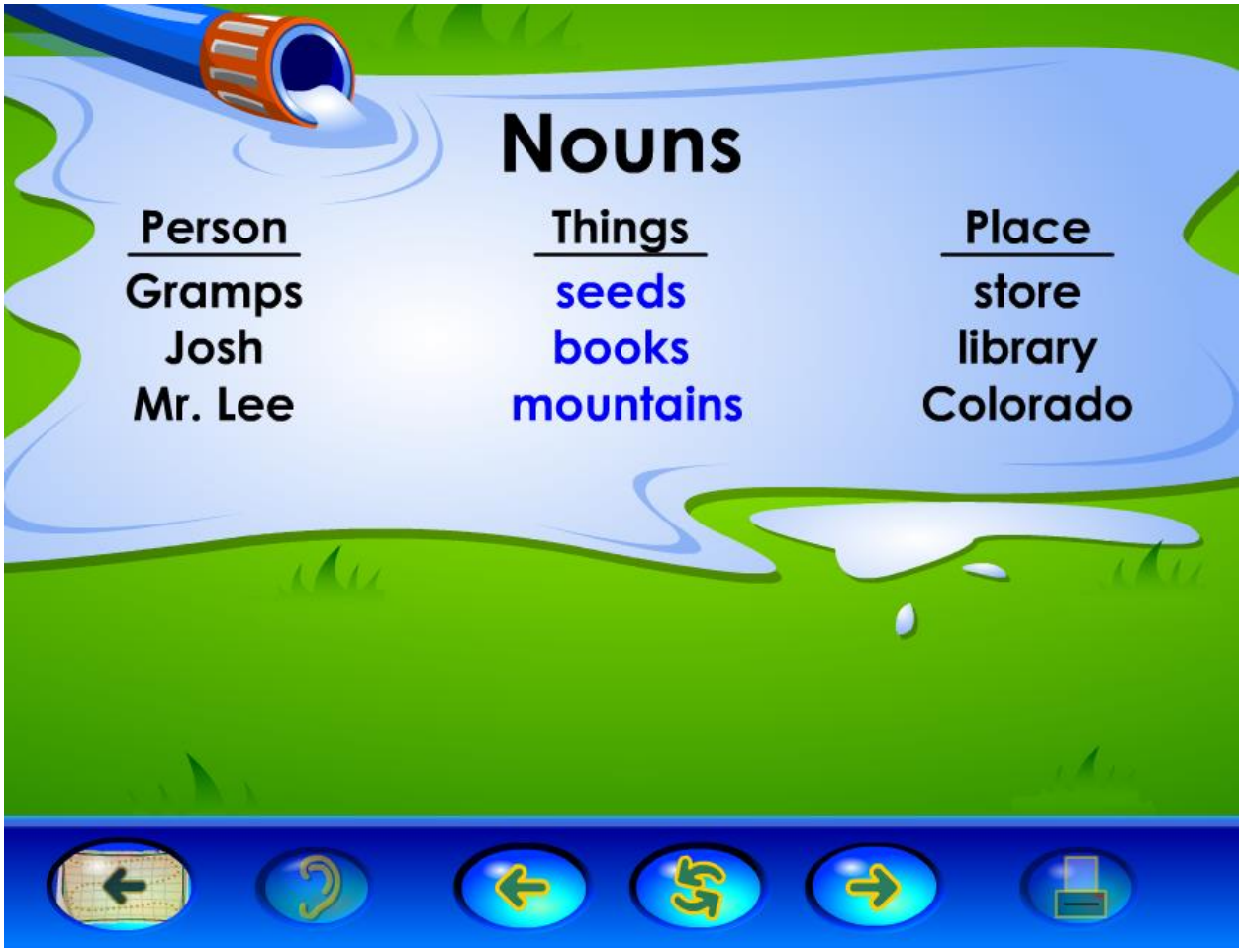
Student Unit Menu

Unit 1 Lesson 1 Start Page

Unit 1 Lesson 1 Prediction Activity

Unit 1 Lesson 1 Sorting Activity

Unit 1 Lesson 1 Map Activity



Unit 1 Lesson 1 Parts of Speech Activity

Unit 1 Lesson 1 Sentence Completion Activity

Appendix C: Qualitative Interview Questions

Qualitative Interview Questions

1. Please describe what it was like for you to use the Destination Reading software.
2. Do you think the use of the software changed how you feel about school? How?
3. Do you think the use of the software changed how you feel about computers? How?
4. Do you think the software helped you to learn to read? How?
5. Is there anything you would like me to know about your experience using the software?

Appendix D: Test Administration Script

GRADE 3 READING COMPREHENSION RESEARCH PROJECT

TEST ADMINISTRATION SCRIPT

Please read these directions carefully before administering the test. When you administer the test, the directions you are to read aloud are preceded by **SAY.** The italicized instructions to teachers should **not** be read aloud.

Review the assent form together and have each student sign it.

SAY Good morning boys and girls. Today you will be taking a test of your reading skills. The test has 4 passages that you will read, and for each passage you will answer 5 questions. This test does not count on your report card and your teacher will not see your grades. For this test please circle the number of the correct answer for each question. Are there any questions about how to answer the questions?

Pause for questions. When you are confident that all students understand how to take the test, distribute the test to each student.

SAY You may make notes, highlight, or underline in this test booklet as you read.

Are there any questions?

Pause for questions. When you are confident that all students understand the directions,

SAY When answering the questions, you may look back at the reading selections as often as you like. When you see the words GO ON at the bottom of the page, go on to the next page. When you come to the word STOP, do not turn the page. You may go

back and check your work, but do not go on until I tell you to do so. You must work independently, and you may not speak with each other while the test is being administered. Are there any questions?

Pause for questions. When you are confident that all students understand the directions,

SAY Since this part of the test measures your understanding of the reading passages you should answer the questions based on the passages you have read. The scores for your answers will not be based on your personal opinion. Now, turn to page 2. Read the story and answer questions 1 through 5. For each question, circle your answer in the test booklet. You will have 9 minutes to read the article and answer the questions about what you have read. I will write the time on the board. You may begin.

Record the time.

Be sure that students are on the correct page and are circling numbers in the test booklet appropriately.

After 9 minutes have passed,

SAY Please stop working. If you have not finished this section of the test, and there is time left during the other sections, you may go back and finish this section. Now, you will read another passage and answer five questions. Look at page 5. Read the passage and answer questions 6 through 10. For each question, circle your answer in the test booklet. You will have 9 minutes to read the passage and answer the questions. When you come to the word STOP, do not turn the page. I will write the time on the board. You may begin.

Record the time.

After 9 minutes have passed,

SAY Please stop working. If you have not finished this section of the test, and there is time left during the other sections, you may go back and finish this section. Now, you will read a poem and answer five questions. Turn to page 8. Read the poem and answer questions 11 through 15. For each question, circle your answer in the test booklet. You will have 9 minutes to read the poem and answer the questions. When you come to the word STOP, do not turn the page. I will write the time on the board. You may begin.

Record the time.

After 9 minutes have passed,

SAY Please stop working. If you have not finished this section of the test, and there is time left during the next section, you may go back and finish this section. Now, you will read an article and answer six questions. Look at page 11. Read the article and answer questions 16 through 20. For each question, circle your answer in the test booklet. You will have 9 minutes to read the article and answer the questions. When you come to the word STOP, do not turn the page. I will write the time on the board. You may begin.

After 9 minutes have passed,

SAY This is the end of this part test. Thank you for your attention. Now we are going to answer some questions about how you feel about computers and school. Turn to page 14 and read question 1 to yourself.

Discuss how to answer the question.

SAY Now let's look at question 2.

Discuss how the answer differs.

SAY Now complete the rest of the questions on your own by reading each question and circling the word that best fits how you feel right now.

When complete collect all test booklets and

SAY Thank you for your participation in this study.

Appendix E: YCCI Scoring Manual Excerpts

(Reprinted and used with permission of the author)

Young Children's Computer Inventory Scoring Manual

INTRODUCTION

The Young Children's Computer Inventory (YCCI v5.27) is a 51-item, 4 point Likert instrument for measuring primary and intermediate (1st through 6th grade) school children's attitudes on seven major subscales. The YCCI is designed to measure attitudes (feelings toward a person or thing) and prevailing attitudes (dispositions), rather than achievement. The seven major indices are:

- **Computer Importance**-perceived value or significance of knowing how to use computers,
- **Computer Enjoyment**-amount of pleasure derived from using computers,
- **Study Habits-**mode of pursuing academic exercises within and outside class,
- **Empathy**-a caring identification with the thoughts or feelings of others,
- **Motivation-**unceasing effort; perseverance; never giving up,
- **Creative Tendencies-**inclinations toward exploring the unknown, taking individual initiative, finding unique solutions, and
- **Attitudes Towards School-**perceived value or significance of school.

Eighteen paired comparisons items also assess children's relative preferences for using a computer versus reading a book, writing a story, and watching television. Relative difficulty and utility for learning are assessed as well.

RECOMMENDED ADMINISTRATION PROCEDURES

The YCCI has been successfully used for group administration to classes in school, as well as for home administration under the supervision of a parent or guardian. Appropriate instructions are included on the two versions of the form:

School use: This questionnaire has 4 parts. Follow along with each statement as your teacher reads it and then circle the number which best shows how you feel.

Home use: This questionnaire has 4 parts. Read and discuss each of the following statements with your child and mark the response your child gives you.

Classroom administration takes 30-40 minutes for a typical primary school class, while home administration is usually faster. A longer time is required in class because the teacher must wait until the slowest student finishes each question before having the groups proceed to the next item. Home administration provides a slightly more reliable response, but it also allows the possibility of parental bias entering into the student's response. Teachers and parents are encouraged to provide explanations of items to the children as needed, but to let the child decide for himself/herself regarding the extent of agreement or disagreement.

First grade teachers have reported success in having students cover their questionnaires with a slotted piece of paper that slides down the page to expose one item at a time. Most students appear to have little difficulty circling a number to indicate how strongly they agree or disagree with an item, once they understand the statement's meaning.

YCCI INTERNAL CONSISTENCY RELIABILITY

Internal consistency reliability estimates for YCCI subscales based on 1992 grade 1-3 data from the USA, Japan, and Mexico are listed in Table 1. These fall in the range "minimally acceptable" to "very good" according to the guidelines provided by Devellis (1991).

Table 1. Internal Consistency Reliability for Combined YCCI English, Japanese, and Spanish Versions based upon 1992 Grades 1-3 Data

Subscale	Alpha	No. of Items
Creative Tendencies	.85	13
Computer Enjoyment	.72	5
Computer Importance	.77	9
Empathy	.77	9
Study Habits	.80	7
Motivation/Persistence	.66	6

Internal consistency reliabilities for the paired comparisons portions of the YCCI are thought to be quite high. A circular triad analysis of 1993 paired comparisons data (n=210) at the University of Hawaii indicated reliabilities of .90 for Computer Preference, .89 for Computer Difficulty, and .92 for Computer Learning (Dunn-Rankin, 1983; Knezek & Miyashita, 1994). Since data from students in grades 4-8 was included in the 1993 analysis, it is probable that the numbers are appropriate for both elementary and middle school students.

STUDIES AND REPORTS USING YCCI

Knezek, G. A., Miyashita, K.T., Lai, M., Sakamoto, T., Southworth, J., & Sakamoto, A. (1994). *Studies on Children and Computers: The 1993-1994 Fulbright Series.* Denton, TX: Texas Center for Educational Technology.

SCORING THE YCCI (v5.27)

The Young Children's Computer Inventory (YCCI v5.27) contains 51, Likert-type self-report items. Students record their own perceptions of the extent to which they agree or disagree with each item, under the supervision of a teacher in the classroom environment, or a parent in the home. Up to seven separate indices can be produced by averaging responses to related items. These indices include two kinds of attitudes toward computers: Computer Importance and Computer Enjoyment; two kinds of attributes related to motivation to study: Study Habits and Motivation/Persistence; Empathy; Creative Tendencies, and Attitudes Toward School. Items for the subscales related to attitudes toward computers and motivation to study can be combined in each category to form more reliable scales. The following sections describe how to score each measurement scale.

LIKERT ITEMS

The seven subscales are Computer Importance (I); Computer Enjoyment (J); Study Habits (S); Empathy (E); Motivation/Persistence (M); Creative Tendencies (C); and Attitudes Toward School (SC). The items of the subscales are distributed among the first four parts of the YCCI (v5.27) and are shown in Table 2.

Table 2. Subscale to Question Conversions.		
Subscale	**Part**	**Question Numbers**
Computer Importance (I)	1	3, 6, 7, 8, 10, 11
Computer Enjoyment (J)	1	1, 2*, 4, 5, 9
Motivation/Persistence (M)	2	2, 3, 7, 8, 9
Study Habits (S)	2	1, 4, 5, 6, 10, 11
Empathy (E)	3	1, 2, 3, 4, 5, 6, 7, 8, 9
Attitudes Toward School (SC)	3	10, 11*, 12, 13*
Creative Tendencies (C)	4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
* negative wording, reverse these 3 items before summing		

The recommended YCCI scoring procedure for the first four parts is to simply average the numeric value of the responses for the related items to produce seven subscales scores. However, three items on the YCCI have negative wording and must be reversed before adding to the others. These items are: item 2 on Part 1 and items 11 and 13 on Part 3. If the student selected 1 or No, change it to 4 or Yes. If a student selected 3 or Maybe Yes, change it to 2 or Maybe No. For example, Computer Enjoyment will be the sum of five items (1, 2, 4, 5, and 9) in Part 1, with item 2 reversed before inclusion in the sum. To generate an average for each subscale, take the sum of the items and divide by the number of items.

If the researcher is using a statistical package, such as SPSS, this guide to the variable numbering used in the "SPSS command application" shown below will be helpful. Even though the items for the seven subscales are distributed throughout the first four parts of the YCCI (v5.27), the variables are numbered sequentially for data entry purposes. For example,

the items in Part 1 are numbered 1 through 11, and also variable (var) 1 through 11. The items in Part 2 are also numbered 1 through 11; however, the variables are 12 through 22. The variables for each subscale are shown in Table 3.

Table 3. Subscale to Variable Conversions.

Subscale	Part	**Variable Number**
Computer Importance (I)	1	variables 3, 6, 7, 8, 10, 11
Computer Enjoyment (J)	1	variables 1, 2, 4, 5, 9
Motivation/Persistence (M)	2	variables 13, 14, 18, 19, 20
Study Habits (S)	2	variables 12, 15, 16, 17, 21, 22
Empathy (E)	3	variables 23 through 31
Attitudes Toward School (SC)	3	variables 32, 33, 34, 35.
Creative Tendencies (C)	4	variables 36 through 48

Appendix F: Letter and Consent Form (Parent)

Mathew Swerdloff
Western Connecticut State University
swerdloff001@connect.wcsu.edu
September 27, 2012

Dear Parent\Guardian of:

In addition to my role as Director of Technology in this district, I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a dissertation research study. The purpose of my study is to investigate the effects of English Language Arts (ELA) instruction using instructional software. Specifically, my study will assess the effect on student reading comprehension, student attitude toward school and student attitude toward computers. This study will take place in the 2012-2013 school year with all grade 3 students in the district.

In the study all students in your child's class will be taking a short online test called the Young Child's Computer Inventory (YCCI) and a previous version of the New York State ELA exam. The YCCI measures student attitude toward school and computers and the ELA exam measures reading comprehension. Each administration of the ELA exam will take approximately 45 minutes. Each administration of the YCCI will take approximately 25 minutes. After these two exams are administered, some of the third grade classes will receive 10 weeks of ELA instruction in school using Destination Reading, a web based reading application. I will be training each teacher and class on the use of the software. The remaining classes will receive no change in instruction until about 10 weeks later. After 10 weeks all students will be assessed again using both exams. Following this the second group

will receive the 10 weeks of software instruction. All students will receive the same instruction-the only variable is time, with one group receiving instruction 10 weeks after the other group.

This study has been reviewed and approved by Western Connecticut State University's Institutional Review Board. The results will enable educators to better understand the effects of instructional software use. Participation in this study is completely voluntary. There is no risk to your child by participating in this research. The exam results are coded to ensure that all responses will be held strictly confidential. The ELA exam results will be provided to your child's home room teacher and used as preparation for the actual ELA exam in April.

Please sign the attached form and return to it your child's homeroom teacher by Friday October 5, 2012. If you have any questions or need clarification please contact me by email or phone at the numbers listed on the consent form. Thank you in advance for your anticipated support.

Sincerely,

Mathew Swerdloff

Director of Technology

SCHOOL DISTRICT

READING COMPREHENSION STUDY PARENTAL CONSENT FORM

Child's Name: School: Teacher:

Parent\Guardian Name: _____

Parent\Guardian Signature: _____

Date: _____

CIRCLE ONE CHOICE BELOW

1 I CONSENT-I acknowledge that I am the legal guardian of the child listed above and I grant consent for him\her to participate in this study. I agree that I have been informed of and understand the nature and purpose of this study and freely consent to my child's participation. I understand that participation is completely voluntary.

2 I DO NOT CONSENT-I acknowledge that I am the legal guardian of the child listed above and I do not grant consent for him\her to participate in this study.

PLEASE RETURN TO YOUR CHILD'S CLASSROOM TEACHER

BY FRIDAY, OCTOBER 5, 2012

This research project has been reviewed and approved by the WCSU Institutional Review Board (IRB). If you have any questions concerning the IRB research application process, please call the WCSU Office of Sponsored Programs and Research at 203-837-8944.

For questions about this specific study contact Mathew Swerdloff

Appendix G: Letter and Consent Form (Superintendent)

Mathew Swerdloff
Western Connecticut State University
swerdloff001@connect.wcsu.edu
September 20, 2012

Dear Superintendent of Schools,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a dissertation research study. The purpose of my study is to investigate the effects of targeted ELA instruction using instructional software applications. Specifically, my study will assess the effect on student reading comprehension, student attitude toward computers and student attitude toward school.

In this study all grade 3 students in the district will receive 10 weeks of targeted ELA instruction using instructional software applications. Instruction will be delivered in the student's regular classroom and in the computer lab. Students will receive the instruction asynchronously in two groups; the first group will serve as the treatment group, the second as the control. All students will receive the same instruction, only the timing of the instrument administration will vary. All grade 3 teachers will be trained by me in using the software. Destination Reading has been selected for the study, a program purchased by the district several years ago. No district funds will be used for this study. This study will provide an opportunity to assess the effectiveness of our current instructional practices and offer information useful for future decisions.

Two instruments will be administered to students; NYS ELA Exam Part 1 (previous versions) and the Young Children's Computer Inventory. All instruments will be administered by me in the student's regular classroom setting. Each administration of the ELA exam will take approximately 45 minutes. Each administration of the YCCI will take approximately 25 minutes.

This research study has been reviewed and approved by Western Connecticut State University's Institutional Review Board. Results of this study will enable educators to better understand the effects of instructional software use. Participation in this study is completely voluntary. The instruments are coded to ensure that all responses will be held strictly confidential. In addition, parents and students will have the option of opting out of the assessment portion of the study.

Sincerely,

Mathew Swerdloff

Permission is granted for the completion of this study in the district.

Superintendent's Signature _____ Date _____

Appendix H: Assent Form (Student)

READING COMPREHENSION PROJECT CHILD ASSENT FORM

We are doing a project to learn about how using the computer affects your feelings about school and your reading ability. We are asking you to help because we don't know very much about how you and kids your age feel about school if they use the computer a lot or a little.

If you agree to be in our project, we are going to ask you some questions about your feelings about computers and ask you to read some passages and answer some questions.

You can ask questions about this project at any time. If you decide at any time not to finish, you can ask us to stop.

If you sign this paper, it means that you have read it and that you want to be in the project. If you don't want to be in the project, don't sign this paper. Being in the project is up to you, and no one will be upset if you don't sign this paper or if you change your mind later.

Date: _____

Name: _____

Signature: _____

Appendix I: Letter and Consent Form (Principal)

Mathew Swerdloff
Western Connecticut State University
swerdloff001@connect.wcsu.edu
September 20, 2012

Dear Elementary Principal,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a dissertation research study. The purpose of my study is to investigate the effects of targeted ELA instruction using instructional software applications. Specifically, my study will assess the effect on student reading comprehension, student attitude toward computers and student attitude toward school.

In this study all grade 3 students in your school will receive 10 weeks of targeted ELA instruction using instructional software applications. Instruction will be delivered in the student's regular classroom and in the computer lab. Students will receive the instruction asynchronously in two groups; the first group will serve as the treatment group, the second as the control. All students will receive the same instruction, only the timing of the instrument administration will vary. All grade 3 teachers will be trained by me in using the software. Destination Reading has been selected for the study, a program purchased by the district several years ago. No district funds will be used for this study. This study will provide an opportunity to assess the effectiveness of our current instructional practices and offer information useful for future decisions.

Two instruments will be administered to students; NYS ELA Exam Part 1 (previous versions) and the Young Children's Computer Inventory. All instruments will be administered by me in the student's regular classroom setting. Each administration of the ELA exam will take approximately 45 minutes. Each administration of the YCCI will take approximately 25 minutes.

This research study has been reviewed and approved by Western Connecticut State University's Institutional Review Board. Results of this study will enable educators to better understand the effects of instructional software use. Participation in this study is completely voluntary. The instruments are coded to ensure that all responses will be held strictly confidential. In addition, parents and students will have the option of opting out of the assessment portion of the study.

Sincerely,

Mathew Swerdloff

Permission is granted for the completion of this study in the school.

Principal's Signature _____ Date _____

Appendix J: NYS ELA and YCCI Scores

NYS ELA and YCCI Scores

Group: 0 = control, 1 = treatment

STUDENT ID	GROUP	ELA PRE	ATT SCHOOL PRE	ATT COMP PRE	ELA POST	ATT SCHOOL POST	ATT COMP POST
1	0	12	16	39	15	16	32
2	0	6	13	36	8	8	30
3	0	16	16	34	18	13	30
4	0	5	13	29	5	6	25
5	0	17	15	40	15	14	44
6	0	17	9	38	15	10	39
7	0	6	13	28	3	7	20
8	0	14	10	38	17	7	40
9	0	6	8	26	9	6	33
10	0	15	10	38	17	10	41
11	0	15	10	38	15	8	42
12	0	8	11	39	8	4	36
13	0	14	8	33	14	4	38
14	0	16	11	36	16	12	39
15	0	18	6	36	18	4	38
16	0	15	7	35	14	10	33
17	0	17	7	38	16	8	41
18	0	8	8	27	6	10	41
19	0	18	11	30	16	9	32
20	0	19	4	37	16	4	42
21	0	16	12	38	12	4	29
22	0	7	9	29	13	7	37

(Appendix J Continues)

(Appendix J Continued)

STUDENT ID	GROUP	ELA PRE	ATT SCHOOL PRE	ATT COMP PRE	ELA POST	ATT SCHOOL POST	ATT COMP POST
23	0	13	5	39	15	7	34
24	0	17	8	35	18	10	34
25	0	16	15	40	15	12	36
26	0	20	14	35	19	10	31
27	0	19	8	27	18	8	29
28	0	18	9	34	16	0	25
29	0	19	13	36	17	14	34
30	0	19	16	33	16	16	32
31	0	19	16	32	15	16	36
32	0	17	10	37	13	14	33
33	0	15	7	25	11	14	34
34	0	11	8	35	6	6	38
35	0	18	4	37	13	7	34
36	0	19	11	23	13	9	21
37	0	19	12	38	12	12	38
38	0	13	11	29	18	9	35
39	0	10	12	33	13	10	38
40	0	9	1	34	12	12	32
41	0	12	13	34	14	12	40
42	0	17	13	39	17	15	42
43	0	19	15	33	18	14	34
44	0	17	9	39	15	10	44
45	0	18	8	36	15	9	40
46	0	14	13	32	11	13	22

(Appendix J Continues)

(Appendix J Continued)

STUDENT ID	GROUP	ELA PRE	ATT SCHOOL PRE	ATT COMP PRE	ELA POST	ATT SCHOOL POST	ATT COMP POST
47	0	11	12	33	8	12	32
48	0	9	13	37	5	13	44
49	0	10	13	29	3	14	32
50	0	16	7	36	20	13	31
51	0	15	13	38	17	12	40
52	0	17	14	35	19	10	33
53	0	14	13	32	16	12	26
54	0	18	10	37	18	7	42
55	0	11	16	33	9	14	21
56	0	14	11	35	11	14	30
57	0	14	6	35	11	13	43
58	0	18	13	39	14	13	38
59	1	7	8	44	14	9	36
60	1	10	10	36	16	8	38
61	1	17	13	36	19	13	44
62	1	16	15	43	16	12	41
63	1	18	11	39	18	10	36
64	1	17	10	40	17	8	36
65	1	20	13	30	20	14	26
66	1	16	12	42	15	13	39
67	1	17	13	37	15	15	36
68	1	12	4	28	10	7	26
69	1	18	5	32	16	4	40
70	1	17	16	43	14	14	42

(Appendix J Continues)

(Appendix J Continued)

STUDENT ID	GROUP	ELA PRE	ATT SCHOOL PRE	ATT COMP PRE	ELA POST	ATT SCHOOL POST	ATT COMP POST
71	1	13	8	34	9	9	24
72	1	19	15	40	14	13	40
73	1	6	7	33	9	6	32
74	1	16	16	41	18	13	37
75	1	16	16	44	17	15	41
76	1	19	14	42	20	14	38
77	1	10	7	41	11	4	41
78	1	17	4	41	18	4	44
79	1	17	13	35	17	11	29
80	1	15	11	38	15	10	36
81	1	19	13	39	19	13	44
82	1	18	11	35	18	14	42
83	1	17	4	36	14	10	39
84	1	13	14	42	16	10	41
85	1	17	15	40	19	14	32
86	1	18	15	35	18	9	31
87	1	8	14	36	8	7	27
88	1	19	13	34	17	14	38
89	1	20	10	33	18	14	40
90	1	18	12	38	15	16	44
91	1	19	12	39	15	11	43
92	1	17	12	39	12	13	43
93	1	18	12	30	18	13	33
94	1	1	13	41	16	13	44

(Appendix J Continues)

(Appendix J Continued)

STUDENT ID	GROUP	ELA PRE	ATT SCHOOL PRE	ATT COMP PRE	ELA POST	ATT SCHOOL POST	ATT COMP POST
95	1	15	13	38	20	10	40
96	1	13	11	34	17	6	30
97	1	11	13	30	15	9	44
98	1	13	4	23	16	8	23
99	1	17	13	42	20	14	43
100	1	11	7	28	13	6	32
101	1	11	11	33	13	7	43
102	1	13	13	40	14	12	40
103	1	17	10	35	18	14	37
104	1	15	10	39	15	11	38
105	1	17	6	34	17	8	30
106	1	20	13	44	20	14	40
107	1	18	13	32	17	14	30
108	1	19	10	28	18	10	31
109	1	19	7	34	14	6	38
110	1	5	9	36	14	5	36
111	1	6	4	38	14	7	33
112	1	7	10	36	11	5	43
113	1	13	16	36	15	13	39
114	1	16	13	38	17	15	33
115	1	14	14	38	15	15	30
116	1	17	10	40	15	12	44
117	1	11	10	44	8	12	44

Appendix K: Qualitative Interview Transcripts

Qualitative Interview Transcript Interview One

INTERVIEWER: This is Interviewer, I'm interviewing Student #1 and it's January 25th at 11:35am. So Student #1 I have a few questions for you about Destination Reading and I want you to just give me your opinion, there's no right or wrong answer. So whatever you think you tell me, alright?

STUDENT #1: Ok.

INTERVIEWER: Alright so the first question is: Can you describe what it was like for you when you were using the Destination Reading software?

STUDENT #1: Um…

INTERVIEWER: Do you need help answering?

STUDENT #1: I'm just trying to remember.

INTERVIEWER: Ok. So how did you feel when you were using it?

STUDENT #1: Like um. I felt like I was learning like a few new things.

INTERVIEWER: Uh huh.

STUDENT #1: And like a few new like pronouns and action words.

INTERVIEWER: Ok. Did you enjoy it or…

STUDENT #1: I enjoyed it.

INTERVIEWER: Was it some other words you could use to describe what it was like for you, some other adjectives? No?

STUDENT #1: It teaches like me new things.

INTERVIEWER: Ok, great thank you. So some of the questions that we asked in that questionnaire were how you feel about school and how you feel about computers. Do you

think that using the Destination Reading software affected how you feel about school in any way?

STUDENT #1: Like it made me smarter.

INTERVIEWER: Ok. Did it change the way you feel about coming to school and being in school?

STUDENT #1: No.

INTERVIEWER: No. Ok. And what about how you feel about computers, did you think that using the software changed how you feel about computers at all?

STUDENT #1: Um, no.

INTERVIEWER: No? Everything's the same?

STUDENT #1: Uh huh.

INTERVIEWER: Ok two more questions. So one of the reasons for using the software was to help kids learn how to read, do you think that the software helped you learn how to read?

STUDENT #1: A little.

INTERVIEWER: Any idea how or can you be specific?

STUDENT #1: Like the stories helped me read like when I was in like kindergarten and still they helped me read a little better.

INTERVIEWER: So you used it before? You used this software before this year?

STUDENT #1: Uh huh.

INTERVIEWER: With your other teachers? Ok, so what about this year do you think it helped you read this year?

STUDENT #1: Yea.

INTERVIEWER: How did it help you?

STUDENT #1: Like I read the stories and then I had to answer questions and sometimes I do that at my house.

INTERVIEWER: Uh huh.

STUDENT #1: Like to help me read better.

INTERVIEWER: So the questioning after the story was helpful?

STUDENT #1: Uh huh.

INTERVIEWER: Ok. And then the last question is so anything else that you think would be good for me to know about what it was like for you to be using Destination Reading, anything that was good, or not good, or fun, or exciting, or boring, or anything about using it?

STUDENT #1: I liked everything about it.

INTERVIEWER: You liked everything about it? Is there anything that you would have improved or done more of?

STUDENT #1: Um, I would um, I like to do The Choice Is Right because after you like read a story they asked you questions.

INTERVIEWER: So that was one of the games?

STUDENT #1: Uh huh.

INTERVIEWER: And did you like the games especially?

STUDENT #1: Uh huh.

INTERVIEWER: What other games did you like?

STUDENT #1: When you had to like connect the words like thoughtful with the ice bricks.

INTERVIEWER: Uh huh. Ok. Was there any part that you didn't like?

STUDENT #1: No.

INTERVIEWER: No? It's all good? Ok. Thank you Student #1, I appreciate your time.

STUDENT #1: Ok.

END OF INTERVIEW

Qualitative Interview Transcript Interview Two

INTERVIEWER: This is a recording of an interview with Student #2. It is January 3, 2013. Can you describe what it was like for you to use the Destination Reading software?

STUDENT #2: Fun.

INTERVIEWER: Can you say any more about it?

STUDENT #2: I don't know.

INTERVIEWER: What was fun about it?

STUDENT #2: The games.

INTERVIEWER: Did you use level 2 and 3?

STUDENT #2: I'm still on level 2.

INTERVIEWER: The games were your favorite part?

STUDENT #2: Yes.

INTERVIEWER: Do you think the use of the Destination Reading software changed how you feel about school?

STUDENT #2: Yes.

INTERVIEWER: How so?

STUDENT #2: On computer or paper?

INTERVIEWER: Is it better…is school better with using Destination Reading?

STUDENT #2: Yea.

INTERVIEWER: Can you say more?

STUDENT #2: Not really.

INTERVIEWER: Do you think that using the Destination Reading software changed how you feel about computers?

STUDENT #2: Yes, but in a good way.

INTERVIEWER: How did you change?

STUDENT #2: Computers can also be used for work.

INTERVIEWER: You used Destination Reading for 10 weeks. Can you describe what that was like?

STUDENT #2: Exciting.

INTERVIEWER: What was exciting?

STUDENT #2: This is the first year we got to use the computer lab.

INTERVIEWER: Do you use computers in class for other stuff?

STUDENT #2: Sometimes yes.

INTERVIEWER: Like what?

STUDENT #2: Looking up states.

INTERVIEWER: Anything else?

STUDENT #2: No, not really.

END OF INTERVIEW

Qualitative Interview Transcript Interview Three

INTERVIEWER: So this is Interviewer and Student #3. Today is January 2, 2013. So I have a few questions for you and it's really just totally your opinion, no right or wrong answers. However you want to answer is fine and this is just for me for my research.

STUDENT #3: Ok.

INTERVIEWER: Ok? And if you could speak up…so the first question is can you tell me what it was like for you using the Destination Reading software these last 10 weeks?

STUDENT #3: Well it was really, really fun. I learned a lot. I loved just reading all of the passages, the books, and it tells you about a lot of interesting things like space and how Jupiter has I think a red dot on it.

INTERVIEWER: Uh huh.

STUDENT #3: It was just amazing. I like it so much and that was all new, we've never been on that before, that kind.

INTERVIEWER: Right, right. Ok. So you like the reading part of it, what about anything else that you particularly enjoyed?

STUDENT #3: I enjoyed…like…I don't really…like all the writing parts that they told me about…like how you should write. They told me two things about that.

INTERVIEWER: You did like that or you didn't?

STUDENT #3: I loved it!

INTERVIEWER: Oh, ok. So remember in the test that I gave you I asked you some questions about how you feel about computers and how you feel about school?

STUDENT #3: Yea.

INTERVIEWER: So my next question is, do you think using the Destination Reading software changed how you feel about school?

STUDENT #3: A lot.

INTERVIEWER: How?

STUDENT #3: I feel perfect now. School is now like my favorite thing.

INTERVIEWER: Uh huh.

STUDENT #3: It told me…like…it made me do math…like use my brainer harder to do math.

INTERVIEWER: Uh huh.

STUDENT #3: And now it's turning out to be fun in school.

INTERVIEWER: Ok, now what about how do you feel about computers? Do you think Destination Reading changed the way you feel about computers?

STUDENT #3: A lot.

INTERVIEWER: How?

STUDENT #3: Now I love computers. I didn't really use computers that much but now I use it every day. I got a computer myself and I really type a lot on it and I'm just getting to love computers.

INTERVIEWER: Uh huh.

STUDENT #3: It's just…computers are now my favorite electronics.

INTERVIEWER: Uh huh.

STUDENT #3: I don't like the iPod Touch anymore because they don't give you…they don't really let you write or do stuff like the computers do.

INTERVIEWER: Ok. And so was there anything about using Destination Reading that you didn't like or that was difficult or challenging?

STUDENT #3: Some parts in reading and telling you about Jupiter got me mixed up.

INTERVIEWER: Uh huh.

STUDENT #3: The words I can read only like once or twice and the writing it's just…it gets hard when they like tell you about everything…you can't like remember it. It's just those parts are really, really hard.

INTERVIEWER: Uh huh. And so last question is there anything else that you think that I should know or that you want me to know about your experience using Destination Reading?

STUDENT #3: I mean you're really good. I just really don't know what you should learn. You're just already really, really, smart about Destination Reading and computers.

INTERVIEWER: Ok, thank you. But anything that you experienced that you didn't tell me about yet?

STUDENT #3: Oh. I didn't experience like the…in space I didn't learn about like all the planets. Jupiter had a red dot on it …I didn't know like any of that.

INTERVIEWER: So you learned a lot about the planets from the reading?

STUDENT #3: Yea.

INTERVIEWER: What else did you learn a lot about?

STUDENT #3: I learned a lot about science and about how to write better, I liked that a lot. And it just changed my life about computers.

INTERVIEWER: Ok good, I'm glad to hear that. Alright, thank you.

STUDENT #3: You're welcome.

END OF INTERVIEW

Qualitative Interview Transcript Interview Four

INTERVIEWER: It's January 2nd at 1:30. This is Interviewer interviewing Student #4.

STUDENT #4: Yes.

INTERVIEWER: Ok, so I have a few questions for you about Destination Reading. Do you remember Destination Reading? Do you remember the software that we used?

STUDENT #4: Yes.

INTERVIEWER: Ok, so the first question is: What was it like for you to use the Destination Reading software?

STUDENT #4: It was like me reading something that tells you a lot of things about like the planet and all that stuff on the Destination number 3.

INTERVIEWER: Did you find it…how did you find it did you find it? Fun or boring or exciting or interesting? What word would you use to describe it?

STUDENT #4: A little interesting…yea interesting I'll say that.

INTERVIEWER: Can you say any more about it?

STUDENT #4: No, it's interesting because you get to use connect and download and a lot of that stuff and I really like that.

INTERVIEWER: So you like level 3 better than level 2?

STUDENT #4: Yea.

INTERVIEWER: What made you like level 3?

STUDENT #4: Because I wanted something that had more facts because level 3 only has games, games, games, games. I wanted something that can read to you…well Destination Reading number 3 can read and number 2 can also read but it's only about games, games,

games, games but I like Destination Reading 3 because you can read, it tells you some things about the things.

INTERVIEWER: And you liked it more because it was more like a game? Is that right?

STUDENT #4: Yea.

INTERVIEWER: Ok. So let me ask you this: Do you think the use of the software Destination Reading changed how you feel about school?

STUDENT #4: The use of Destination Reading…no.

INTERVIEWER: You feel the same way about school than you did 10 weeks ago before?

STUDENT #4: Yea.

INTERVIEWER: Ok. What about how you feel about computers? Do you think the use of the software changed how you feel about computers?

STUDENT #4: No…what was the question again?

INTERVIEWER: Do you think that using Destination Reading changed how you feel about computers?

STUDENT #4: No it didn't.

INTERVIEWER: How do you feel about computers?

STUDENT #4: Well computers are good not only for games for school work, homework and all that stuff.

INTERVIEWER: Ok. Thank you. Is there anything that you would like me to know about your experience using Destination Reading?

STUDENT #4: Yes.

INTERVIEWER: What?

STUDENT #4: Well it's really…it's fun…kind of funny.

INTERVIEWER: Funny or fun?

STUDENT #4: Fun and funny.

INTERVIEWER: What was fun about it?

STUDENT #4: Because that part about "Hey who turned out the lights" that was funny.

INTERVIEWER: Uh huh.

STUDENT #4: Yea. And also fun because you get to use tools and it has sticker things that I was checking things out on the tools.

INTERVIEWER: Uh huh.

STUDENT #4: Yea. So it's really fun.

INTERVIEWER: Ok, that's great. So thank you for your time. Is there anything else you want to say to me?

STUDENT #4: No.

INTERVIEWER: Ok. That's the end of this interview.

END OF INTERVIEW

Qualitative Interview Transcript Interview Five

INTERVIEWER: This is Interviewer interviewing Student #5, January 4, 2013. So I'm going to ask you some questions about Destination Reading. The first one is can you tell me what it was like for you to use Destination Reading?

STUDENT #5: It was fun because you got to learn stuff without having to write it down and you got to use the computer.

INTERVIEWER: Ok. Was there one part of it that was the most fun for you?

STUDENT #5: The most fun for me was the one with the monkey.

INTERVIEWER: The story with the monkey?

STUDENT #5: Yea.

INTERVIEWER: And did you do level 2 and level 3 or just level 2?

STUDENT #5: Just level 2, I didn't get past level 2 yet because I always have to start over.

INTERVIEWER: Ok. So remember one of the questions was in the written test was how you feel about school. Do you think that using Destination Reading changed how you feel about school?

STUDENT #5: Yes.

INTERVIEWER: How?

STUDENT #5: Because it made me realize that school is a good way to have you learn instead of having you not learning anything.

INTERVIEWER: Ok. And what about how you feel about computers, do you think that using the software changed how you feel about using computers?

STUDENT #5: No.

INTERVIEWER: No? You feel the same?

STUDENT #5: Yea.

INTERVIEWER: Ok. So how do you think Destination Reading changed the way you read? Do you think it changed the way you read at all or how you read?

STUDENT #5: No because a part of it was blurry to me because I think I need glasses.

INTERVIEWER: You were telling me that the test was blurry right?

STUDENT #5: Yea.

INTERVIEWER: So I think you do need glasses.

STUDENT #5: I got my eye exam on the 27th.

INTERVIEWER: Oh good, ok. So is there anything else about using the software that you think you want me to know?

STUDENT #5: No.

INTERVIEWER: Ok. What part was the most interesting for you about using the software?

STUDENT #5: What does interesting mean?

INTERVIEWER: Interesting means like something that you are…

STUDENT #5: Something that you like or something?

INTERVIEWER: It could be like or dislike but something that gets your attention.

STUDENT #5: I really like how you have to type stuff about the story.

INTERVIEWER: Ok.

STUDENT #5: Because it confuses me.

INTERVIEWER: Uh huh.

STUDENT #5: And that's pretty much it.

INTERVIEWER: OK. Alright, thank you Student #5.

END OF INTERVIEW

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