10-25-2013

# The Effects of English Language Arts Instruction Using Multimedia Applications on Grade Three Students' Reading Comprehension, Attitude Toward Computers, and Attitude Toward School

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2013

Abstract

The purpose of this study was to investigate the specific effects of targeted English Language Arts 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 multimedia applications. In this study, targeted English Language Arts instruction was compared to similar instruction of English Language Arts skills with the addition of multimedia software applications.

In this study a sampling of approximately 120 grade 3 students in a medium-sized suburban school district received 10 weeks of targeted English Language Arts instruction using traditional teaching methods. From this sample, approximately half of the students received instruction with English Language Arts multimedia applications in lieu of a portion of the allotted English Language Arts 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 English Language Arts 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 English Language Arts 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.

## Computer Aided Instruction

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.

These two meta-analyses offered a general 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. 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.

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.

## 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, 1998). 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.

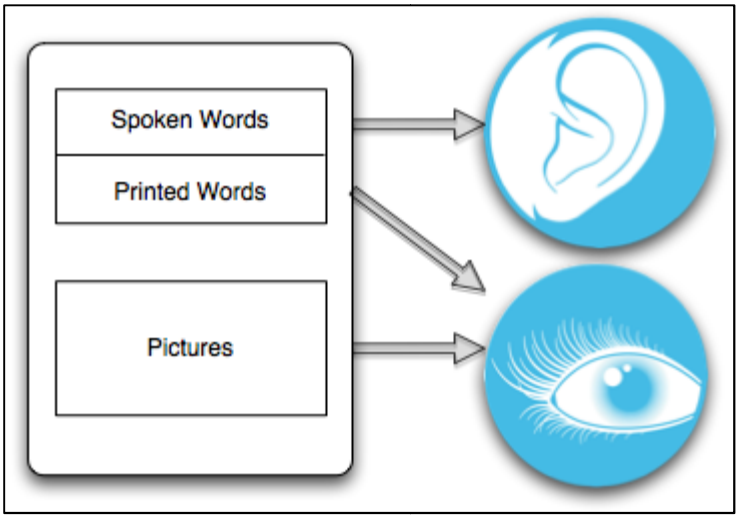



*Figure 1.* Processing of Information Using the Visual and Verbal Channels.

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.

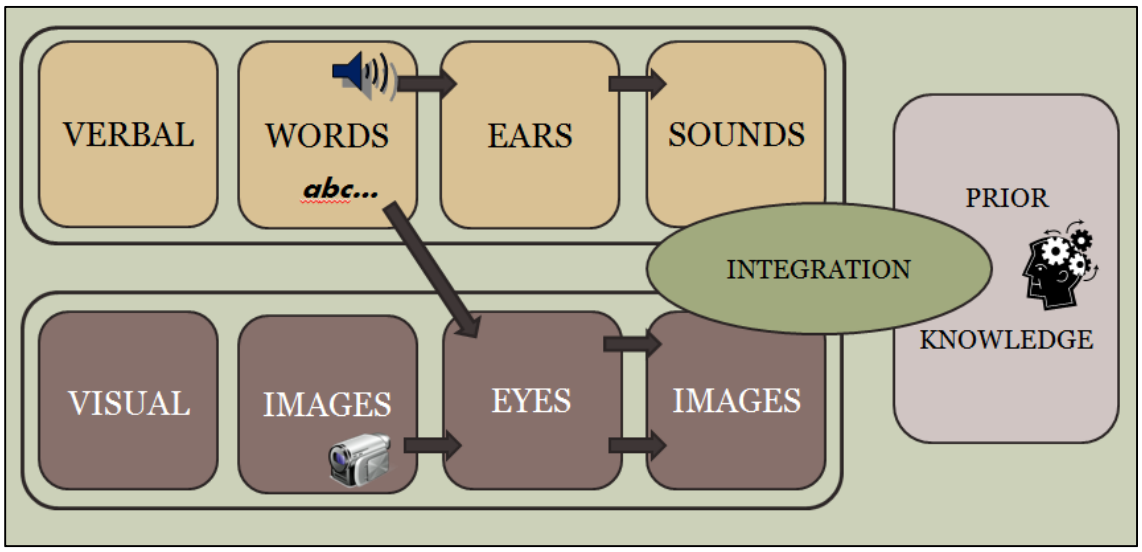



*Figure 2.* Cognitive Theory of Multimedia Learning This figure is a flowchart depicting how information is processed through both the verbal and visual channels through two memory spaces. Adapted from Jeren, Pale, and Petrovicyer (2012).

## 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.

## 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).

## Methodology

This study was conducted in a public school district with a sample selected from the entire population of third grade students. The site of this study was a medium-sized ( < 2,500 students) suburban Mid-Atlantic school district that is within commuting distance of a major metropolitan area. 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.

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 pretest groups for the posttest MANOVA.

Posttest 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 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.

*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 |

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.

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 (New York State Testing Program, 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). 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. 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). 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.

*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 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 all data at a later date.

**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.

## 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.

## 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, Gamst and Guarino, 2006). Descriptive statistics tables were used to verify skewness and kurtosis values.

**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.

**Identification of Posttest Outliers**

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.

**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). 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).

**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.

**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.

*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 |

**MANOVA Results**

A significance level above .05 on *Wilks' lambda* 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 computers, and attitude toward school. The MANOVA data revealed that the multivariate score of the treatment group was significantly higher than that of the control group, *Wilks' lambda*, $F(3,113) = 3.313$, $p = .025$, *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.

*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.

*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 |

**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*, $F(3,113) = 3.313$, $p = .025$, *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).

### 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.

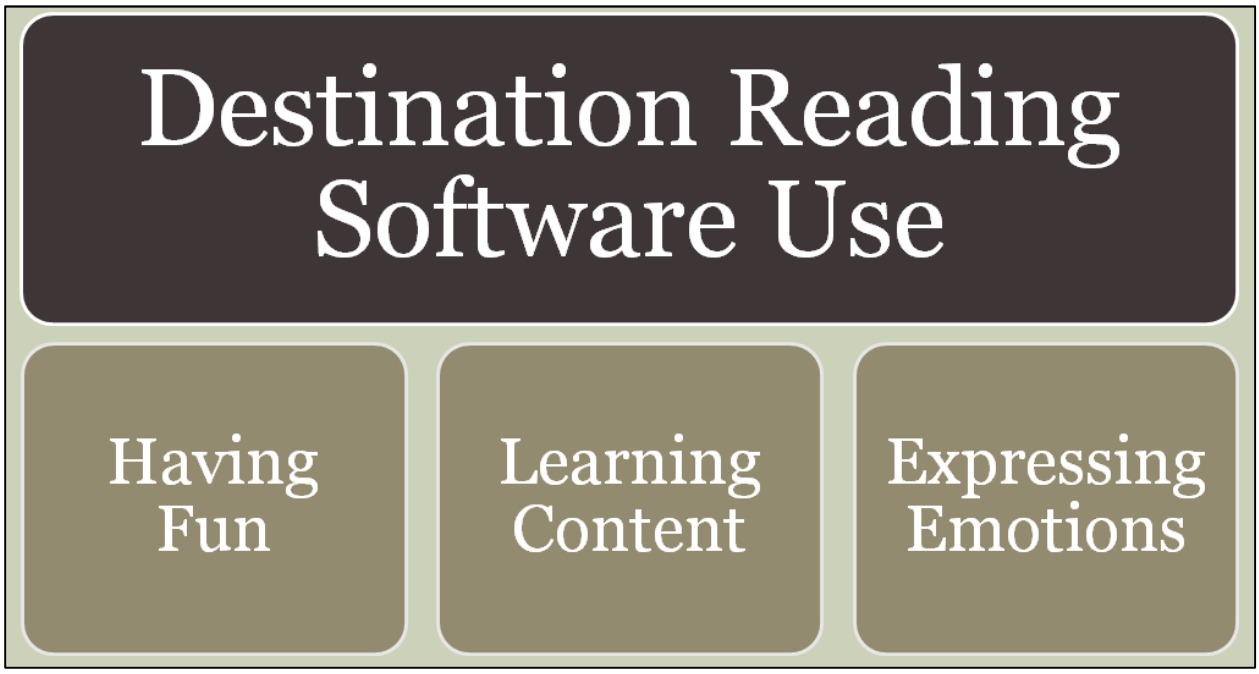
Using a spreadsheet application, calculations of score growth were carried out on pretest and posttest scores to produce a net change in the reading comprehension score for each student. Scores in this column were sorted by size and class, and the student with the largest net gain in reading comprehension 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.

*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 |
| 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.




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.

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.

## 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.

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