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An effectiveness assessment of the Quicktionary reading pen for grades 3 through 6

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Abstract

Testing of 24 students in an Iowa public school in third, fourth, fifth, and sixth grades was conducted to determine if the Quicktionary Reading Pen improved reading accuracy. This was done using reading scores both with and without the pen and a standard t-test with the presence of the pen being the only variable in the study. The reading pen was found to have a positive effect, most notable with students with a reading accuracy below 90%. The increase was statistically significant at an 80% confidence interval or better. The pen had little effect for initial reading accuracy in excess of 95%.

**AN EFFECTIVENESS ASSESSMENT OF THE QUICKTIONARY READING PEN
FOR GRADES 3 THROUGH 6**

A Graduate Research Paper

Submitted to the

Division of Educational Technology

Department of Curriculum and Instruction

in Partial Fulfillment

of the Requirements for the Degree

Master of Arts

UNIVERSITY OF NORTHERN IOWA

By

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FOR GRADES 3 THROUGH 6

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ABSTRACT

Testing of 24 students in an Iowa public school in third, fourth, fifth, and sixth grades was conducted to determine if the Quicktionary Reading Pen improved reading accuracy. This was done using reading scores both with and without the pen and a standard *t*-test with the presence of the pen being the only variable in the study. The reading pen was found to have a positive effect, most notable with students with a reading accuracy below 90%. The increase was statistically significant at an 80% confidence interval or better. The pen had little effect for initial reading accuracy in excess of 95%.

INTRODUCTION

Introduction to the Problem

Incorporating technology into the reading curriculum can benefit low achieving students in word recognition skills and comprehension. There is a strong relationship between a student's decoding accuracy, word recognition processes, and overall reading performance. This project will look at the literature on improving reading skills with technology. The results of action research using the Quicktionary Reading Pen by Wizcom Technology with students reading at grade level and students identified for special education in reading will be examined for word recognition accuracy.

Statement of the Problem

When students, especially those with reading difficulties, come across words they do not know they must stop reading and attempt to decode the word by looking up the word in a dictionary, or skipping the word. This ultimately impedes their reading practice and comprehension by missing valuable learning information and discourages them from reading more than is minimally required. Students need reading strategies to quickly decode words/or assistive technology in order to read all the words. Improved reading comprehension and vocabulary skills create more independence and confidence.

The hypothesis investigated was whether or not the use of the Quicktionary Reading Pen improved oral reading accuracy. An assessment of the retention rate of words that were scanned was made 24 hours later to determine if the scanned words were incorporated into long term memory. Students in grades third through sixth participated in the study.

The Quicktionary Reading Pen by Wizcom Technologies Ltd. is a hand-held, pen shaped scanning device that allows the user to scan printed words, hear the text and definitions read aloud with integrated text-to-speech capability, and see the definitions on the LCD screen. The built-in voice provides pronunciation for a single word or a line of text and recognizes over 200,000 words and expressions from the American Heritage College Dictionary 3rd Edition.

To scan a word the user begins approximately one-fourth inch before the word and going past the end of the word. The user gently glides the Reading Pen with enough pressure to turn the wheels down the center of the word using the guideline on the front of the scanner for placement. Scanning can be either from left to right, or right to left over the word depending on user preference. When the Pen is lifted from the page, the device recognized that scanning has ended and enunciates the word or text if scanning was successful. If the device does not recognize the word or text, an error message “word not recognized” is displayed and the escape button (ESC) must be pressed to reset the device so that the word can be rescanned. A list of up to 80 scanned words are saved in the word history file and can be reviewed. The Reading Pen can be set for right- or left-handed users.

To determine instructional reading levels, a *Basic Reading Inventory* was administered by the researcher to each student reader participating in the study. Students were given passages to read at their individual instructional reading level. In some cases, the passages were above their grade level and in others below their grade level. Each sample of reading material was read silently by the student, and then the same passage was read aloud to the researcher. A running record was kept during the reading

aloud to identify the reading accuracy. For those test samples that included the Reading Pen, the Reading Pen automatically recorded the number of words scanned during the silent reading. The Reading Pen was not used during the reading aloud before the researcher. The numerical results of this testing were tabulated and statistical analysis performed.

Definition of Terms

- 1) Analytical Reading Inventory – Reading passages used to determine reading level.
- 2) Basic Reading Inventory – Individually administered reading tests used by a classroom teacher to determine independent instructional or frustrational reading level.
- 3) Confidence intervals (confidence limits) - The properties of a distribution that identify the limits that bound a true value within the distribution. For a Normal Distribution the confidence limits represent the same deviation from the average, both above and below the average.
- 4) Confidence level – The percentage of those estimates providing intervals that actually would contain the true value of the population parameter being estimated.
- 5) Identified – Student with an Individual Education Plan and receiving services for reading.
- 6) Non-identified – Student who is reading at or above grade level in the general education classroom.
- 7) Quicktionary Reading Pen – Portable assistive reading technology instrument also referred to as the Reading Pen.

- 8) Read Naturally – Leveled reading program with 24 high-interest, non-fiction stories at each reading level.
- 9) t - test – A method of comparing two variables, usually to test the significance of the difference between two samples.

REVIEW OF LITERATURE

This review of literature will examine the use of technology to improve student reading skills. Children are expected be able to read proficiently and discuss fiction and nonfiction texts by the time they finish elementary school. At the same time, teachers are being encouraged to incorporate technology into their curricula (Baker, 2000).

Technology standards for educational leaders developed by the International Society for Technology in Education (ISTE) state that educators are to provide for learner-centered environments that use technology to meet the individual and diverse needs of learners. Simic (1993) stated that the use of technology should foster active involvement, and support and extend student's knowledge. McCullough (1995) noted that the use of technology helps the student to understand, to remember, and to apply the knowledge in other settings.

The use of computer assisted instruction (CAI), hypermedia, hypertext or responsive text, and text-to-speech systems can be ways to incorporate technology for students who have difficulty meeting the literacy requirements for word identification (decoding) and comprehension of written text. What follows is a review of each of these assistive technologies to improve word recognition and comprehension.

In the traditional sense of literacy, students connect concepts and meaning with printed words, recognize and use letter patterns to make new words, and analyze and use structural elements such as affixes and roots to create words (Bromley, 2002). The Standards for the English Language Arts number three (NCTE and IRA, n.d.) states:

Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experiences, their interactions with

other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).

There is good evidence that inefficient decoding is causally related to poor reading comprehension (Jones, Torgesen, & Sexton, 1987). If students are unable to read many of the words on a page they will have difficulty creating meaning from the text which is the ultimate goal of reading. The needs of the individual student can be met through the use of educational technology such as computer assisted instruction.

Computer Assisted Instruction

Computer assisted reading instruction should focus on meaning and stress reading comprehension by having students work with word-recognition programs that stress meaning in addition to phonics and structural analysis (Simic, 1993). Roth and Beck (1987) looked at the effectiveness of the programs *Construct-A-Word* and *Hint and Hunt* on phonological awareness and decoding skill (both accuracy and efficiency) and the degree of transfer of decoding improvements to comprehension with fourth grade students at two inner city schools from low socioeconomic backgrounds where many were performing below grade level. They found the effects for decoding and comprehension to be statistically significant for both the low- and medium-ability groups but not for the high-ability groups. They concluded that these programs may be useful for remedial instruction.

Jones, Torgesen, and Sexton (1987) also evaluated the *Hint and Hunt (HH) Program* on speed and accuracy of word analysis skills with 20 school-identified learning disabled students. The children in the experimental group improved substantially in both

speed and accuracy of word reading as the result of practice with HH program. This improvement occurred for the generalization words, as well as for the target words. This study did not attempt to assess the effects of increases in decoding fluency on reading comprehension.

Hypermedia, Hypertext or Responsive Text

Several different terms have been used to describe the new technologies—multimedia, hypertext, hypermedia, integrated media—but most applications can be reduced to the notion of providing readers with new data and/or strategies for understanding, locating, and processing information (Higgins & Boone, 1993). Reinking and Schreiner (1985) used the computer to allow fifth and sixth grade students to interact with text to determine the effect on reading comprehension. Four types of enhancements to the electronic passages were used: (a) definitions of difficult vocabulary words, (b) passage paraphrases with lower readability levels, (c) supplemental background information in the form of additional text or illustrations, and (d) a statement of main ideas for the passage. Students who were required to view all of the available manipulations, such as advance organizers, inserted questions, pictures, and adjacent-to-text glosses, obtained scores which were significantly higher than when student selected options. By having the computer relieve the processing burden on the reader comprehension may increase.

Text-to-Speech

Less skilled readers use inaccurate and/or inefficient word recognition processes due to an inability to decode multiple sources of information (Roth & Beck, 1987). Computers and handheld technology are well suited to provide speech feedback to

students when confronted with unknown words either in isolation or in connected text (MacArthur, Ferretti, Okolo, & Cavalier, 2001). Text-to-speech technology can provide corrective feedback and assistance when students do not know how to proceed.

Olson, Foltz, and Wise (as cited in Higgins & Boone, 1993) worked with 15 students with reading disabilities between 8 and 12 years of age. Students read stories on the computer screen and could select unfamiliar words to be spoken to them by highlighting the text. Three different speech variations were provided to students: whole-word, syllable, or subsyllable. Gains in word recognition and comprehension were noted with both whole-word and syllable speech variations but not with subsyllable segmentation. Students with poor phonological awareness had difficulty blending

Kim Miller (personal communication, October 4, 2002) is a special education teacher at an Iowa school who looked at the effectiveness of the Reading Pen II with fourth, fifth, and sixth grade students on word identification and vocabulary. Six students were selected from each grade (three with reading difficulties and three at grade level). Students used the Reading Pen, a portable assistive reading technology, to scan an unfamiliar word and hear the whole word read back to them. Six of the nine students with reading difficulties showed improvement in oral reading accuracy and word retention when using the Reading Pen whereas students without reading difficulties did not show any improvement. This study suggested that the Reading Pen does make a difference in the error rate of students with reading difficulties.

Summary

Research indicates (Roth & Beck, 1987; Jones, et al., 1987) that the use of technology improves performance for students with reading disabilities or difficulties.

Computer assisted instruction provided opportunities for students to practice decoding skills and phonological awareness needed for word identification. Remedial instruction was shown to benefit students performing below grade level. Hypermedia, hypertext or responsive text provided students with strategies for processing and comprehending information. Learning occurred more rapidly in an interactive environment where students were provided with multiple types of learning enhancements. Text-to-speech feedback improved student decoding and word recognition skills with whole word feedback providing the greatest improvement. Students may have difficulty blending segmented words.

Multiple technologies are available to improve student reading and comprehension skills (Reinking & Schreiner, 1985; Higgins & Boone, 1993). Teachers incorporating technological approaches that incorporate student engagement and feedback are likely to see improvement in achievement among students with learning disabilities or reading difficulties. The emphasis should not be on using technology for drill and practice but rather on using technology to support and extend students' knowledge by applying the skills taught in some meaningful way (Semic, 1993).

METHODOLOGY

Subjects

A total of 24 students in third grade through sixth grade, enrolled in a public school in Iowa, participated in this study. At each grade level three special education students identified for reading services and three general education students reading at or above grade level were selected as participants in the study.

Representing the identified group of the third grade were one African-American and two Caucasian males. The non-identified third grade students consisted of two female and one male Caucasians. The fourth grade identified group included one African-American female and two Caucasian males. In the non-identified fourth group there was one African-American female, one African-American male, and one Caucasian male. The fifth grade group consisted of three Caucasian males identified for reading and two Caucasian females and one Caucasian male who were not identified. Sixth grade group consisted on three identified male Caucasians. The non-identified sixth grade group consisted of two Caucasian females and one African-American male. The instructional reading levels of the participants were estimated through the administration of the *Basic Reading Inventory* (2001). No analysis of reading data was performed with regard to either race or gender.

Instruments

Read Naturally (2000) leveled reading passages were used for the study for students reading at or below seventh grade level. The passages were individualized so as to be at each student's instructional level. The leveled passages were randomly selected for each student so that no two grade level students would read the same passage.

Passages from the *Analytical Reading Inventory* (1989) were used for two students who were reading instructionally at eighth and ninth grade levels.

Quicktationary Reading Pen Training

Students were trained in how to use the Reading Pen in groups of three and given up to one week to practice. Once the students decided they were comfortable using the Reading Pen, they were tested to determine their scanning accuracy. Each student was given a *Read Naturally* passage Level 5.8 with six bolded words which they were asked to scan. They were allowed two attempts at scanning each word. If they required a third attempt the word was scored as inaccurately scanned. Students who were able to scan at least five out of six words accurately (83%) in two or less attempts were included in the study. All 24 students in the third through sixth grades were able to scan with 83% accuracy or better and were included in the study.

RESULTS

Organization

The average reading accuracy for all the participants in the testing are summarized in Tables 1 and 2. The column headed “ID’d” represents whether or not the students are identified for special education in reading with either a “Y” for yes (identified) or a “N” for no (non-identified). These tables represent the percentage of correct words read by each student for each passage for the six days of testing. During the first and sixth days students read new passages without (abbreviated w/o in the Tables) using the Reading Pen. The second day they used the Reading Pen while reading a new passage and the third day did not use the Reading Pen but the passage was a rereading of the same passage as the second day. The fourth and fifth days used the same procedure as the second and third days, but with a new passage. Reading passages were performed at instructional level, as previous discussed, to represent typical classroom conditions.

A comparison of the first and sixth days does not show an overall increase in reading accuracy for the term of the six day testing period. The differences between Day 1 and Day 6 average to near zero, so no net increase was assumed. The remainder of the analysis was based on the comparison of the accuracy of the readers without using the Reading Pen by averaging Day 1 and Day 6 in order to increase the sample size for a more representative overall average.

Baseline accuracy without using Pen			
Passage 4 Day 6 w/o Pen	Passage 1 Day 1 w/o Pen	ID'd	Grade
94.44%	97.53%	Y	3
96.02%	94.94%	Y	3
94.58%	96.91%	Y	3
95.24%	95.98%	N	3
98.48%	97.03%	N	3
96.97%	95.14%	N	3
85.90%	83.85%	Y	4
79.90%	86.21%	Y	4
81.75%	86.51%	Y	4
97.20%	98.42%	N	4
98.31%	98.15%	N	4
96.30%	97.39%	N	4
96.26%	98.01%	Y	5
97.31%	98.53%	Y	5
79.89%	91.61%	Y	5
96.88%	98.74%	N	5
98.15%	95.87%	N	5
94.94%	95.02%	N	5
97.20%	96.97%	Y	6
94.59%	88.83%	Y	6
93.85%	91.98%	Y	6
97.24%	96.50%	N	6
97.28%	96.50%	N	6
96.55%	96.18%	N	6

Table 1

Table 2 represents those samples of reading that included use of the Reading Pen. Day 2 is the accuracy for a reading sample of a new passage using the Reading Pen, and Day 3 is the accuracy for rereading the same passage read on Day 2 without using the Reading Pen. Similarly, the Day 4 reading is a new passage with the Reading Pen, and Day 5 is a rereading of the same Day 4 passage without the Reading Pen.

Change in retention after using Pen							
Grade	ID'd	Passage 2			Passage 3		
		Day 2 with Pen	Day 3 w/o Pen	Change	Day 4 with Pen	Day 5 w/o Pen	Change
3	Y	90.70%	95.35%	5.13%	95.51%	96.79%	1.34%
3	Y	93.98%	95.78%	1.92%	98.28%	98.28%	0.00%
3	Y	98.82%	100.00%	1.19%	98.31%	98.31%	0.00%
3	N	99.09%	99.09%	0.00%	99.00%	99.00%	0.00%
3	N	96.08%	99.15%	3.20%	96.08%	97.55%	1.53%
3	N	96.14%	99.52%	3.52%	97.06%	98.04%	1.01%
4	Y	87.41%	91.85%	5.08%	85.99%	90.45%	5.19%
4	Y	93.18%	96.02%	3.05%	90.13%	95.39%	5.84%
4	Y	92.86%	93.65%	0.85%	81.45%	87.90%	7.92%
4	N	97.63%	100.00%	2.42%	98.58%	99.29%	0.72%
4	N	100.00%	99.21%	-0.79%	96.56%	97.94%	1.42%
4	N	96.83%	98.94%	2.19%	97.11%	99.17%	2.13%
5	Y	97.49%	97.99%	0.52%	96.32%	96.32%	0.00%
5	Y	100.00%	100.00%	0.00%	95.52%	99.00%	3.65%
5	Y	82.35%	87.70%	6.49%	82.16%	87.03%	5.92%
5	N	96.97%	97.98%	1.04%	97.63%	97.63%	0.00%
5	N	99.53%	99.07%	-0.47%	98.95%	99.48%	0.53%
5	N	96.96%	97.30%	0.35%	97.20%	98.95%	1.80%
6	Y	98.09%	98.09%	0.00%	96.73%	98.18%	1.50%
6	Y	96.53%	98.27%	1.80%	94.61%	94.12%	-0.52%
6	Y	96.72%	98.36%	1.69%	95.41%	95.41%	0.00%
6	N	96.80%	98.40%	1.65%	100.00%	99.65%	-0.35%
6	N	97.26%	98.63%	1.41%	97.92%	98.61%	0.71%
6	N	95.20%	96.40%	1.26%	99.29%	99.64%	0.36%

Table 2

Comparing the Day 3 rereading to the Day 2 original passage shows a small, but positive retention when rereading the same passage. This increase in accuracy is about 2%, and represents long term retained memory for the words scanned in the passage since the Day 3 reading was without the Reading Pen. This increase also probably represents familiarity with the passage rather than influence by the Reading Pen since the differences in average accuracy from reading original passages between Day 2 and Day 4 is negligible. A nearly identical effect occurs when comparing the minor increase from Day 5 rereading to the Day 4 original passage and differences in average accuracy between Day 3 and Day 5 is also negligible.

Based on these observations, the reading observations of Days 2 and 4 were also averaged to provide a similar sample size for comparison of averages with the Reading Pen to those without the Reading Pen, represented by averaging Day 1 and Day 6. The results of Days 3 and 5 were not used in further analysis, as their averages represent a skew due to familiarity of the passages.

Statistical Analysis.

Hypothesis Testing. Because instructional level reading was used instead of frustration level reading, the average accuracy of the students was relatively high, which is to be expected when reading at instructional level. Since these averages were very close in magnitude, additional statistical measures were applied to determine if the averages represented actual changes in accuracy, or were statistically insignificant. The method used for comparison was the calculation of statistic known as the *t*-test. This test is a method of comparing two variables, usually to test the significance of the difference

in averages of two samples. This statistic is applied in conjunction within certain “confidence limits”, the statistical confidence with which the statement can be made.

In a normal distribution, the true value will be found within the limits of the stated confidence interval or confidence level. The confidence level is the area under a normal distribution curve that represents the area within certain limits. The area under the curve beyond the “tails” of a normal distribution represents the probability that the true value is not within those limits. For example, the true value of an average with a confidence level of 90% will be within the limits that represent 90% of the area of a normal distribution curve with a 10% probability that the true average lies beyond either the upper 5% of the tail or the lower 5% of the tail of the normal distribution. This statistic is further identified by whether the area considered for the confidence level is for only one “tail” of the distribution curve (one-sided) or both tails (two-sided). In this application, a two-sided confidence level is used to compare the two averages as a test to determine if the averages have or have not actually changed.

Normal distributions are usually for the hypothesis testing for sample sizes that include 30 or more samples. The “ t ” distribution is similar to a normal distribution, i.e. bell-shaped and symmetrical about the mean, approaches a normal distribution when the sample size is large. For practical purposes, the t -test is applied to a sample size less than 30, and the area under the distribution curve is taken from published tables. The t -test distribution (also known as Student- t distribution) was first investigated in 1908 by W.S. Gosset, who published his findings under the pen name of “Student” because his employers did not permit the publication of research done by their staff (Miller & Freund,

1965). A table is included in Appendix A (Lapin, 1990) which is a composite and abridged table for a two-sided test and the range of confidence levels used in this paper.

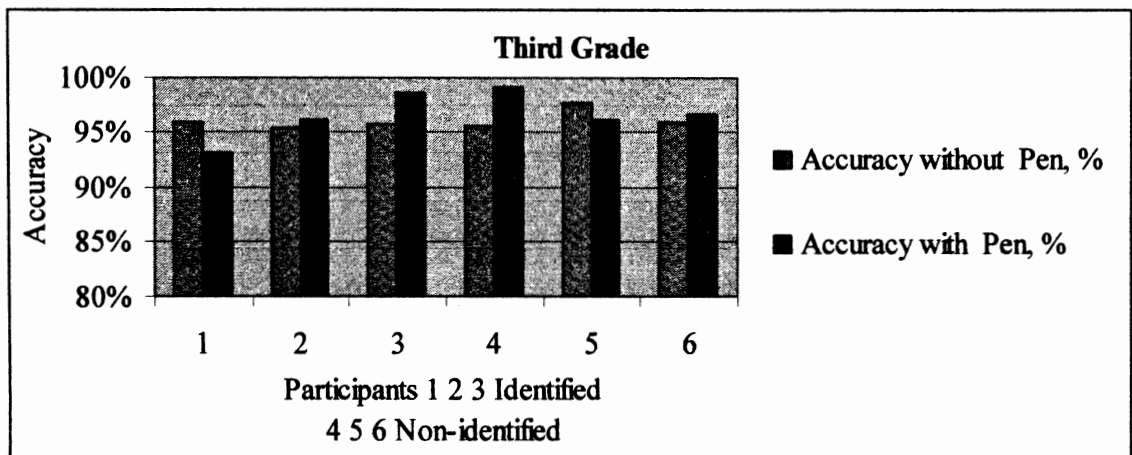
For each participant there were two days of samples of reading for both without the Reading Pen (Days 1 and 6) and with the Reading Pen (Days 2 and 4). For analysis purposes, the number of samples, n , was 6 for each group of identified and non-identified readers. This number of samples provides $n-1$, or 5 degrees of freedom for the t -test distribution.

Comparisons. Analysis of the entire population of all four grade levels did show a small positive increase in accuracy for the use of the Reading Pen within an 80% confidence level. However, analyzing the combined four grades but separating the identified students from the non-identified students showed a high degree of confidence for a small increase in accuracy for the non-identified students, but no statistically significant increase for identified students. These observations were exclusively due to the non-identified reader accuracy having a very low standard deviation, and the identified reader accuracy to have a high standard deviation. These results regarding the overall total population indicated that additional analysis of individual groups was warranted to identify effects.

Statistical analysis for third, fourth, fifth and sixth grades, was performed separately. The analysis was further broken down into comparisons for identified and non-identified readers at each grade level. Separate averages, standard deviations, and t -tests were performed for each of the 8 groups. These results present more insight into the reading samples that were taken. These results are graphically summarized for each grade level.

Third Grade

As shown on Table 3, the third grade identified readers had an average of 95.74% without the Reading Pen and 95.93% with the Reading Pen, a statistically insignificant increase. The third grade non-identified readers had an average of 96.47% without the Reading Pen and 97.24% with the Reading Pen, a statistically significant increase within a confidence interval of 80%. This group indicated that the Reading Pen had little effect when reading at a 95% accuracy level.



Third Grade Accuracy Results - Identified					
Day 1 w/o Pen	Day 2 with Pen	Day 3 w/o Pen	Day 4 with Pen	Day 5 w/o Pen	Day 6 w/o Pen
97.53%	90.70%	95.35%	95.51%	96.79%	94.44%
94.94%	93.98%	95.78%	98.28%	98.28%	96.02%
96.91%	98.82%	100.00%	98.31%	98.31%	94.58%

Reading Accuracy without Pen 95.74% Std. Dev. 0.0129

Reading Accuracy with Pen 95.93% Std. Dev. 0.0319

t - test = 0.369

Less than 1.476 so within a 80% confidence interval we cannot say that the Reading Pen did increase the reading accuracy when looking at the third grade identified.

Third Grade Accuracy Results - Non-identified					
Day 1 w/o Pen	Day 2 with Pen	Day 3 w/o Pen	Day 4 with Pen	Day 5 w/o Pen	Day 6 w/o Pen
95.98%	99.09%	99.09%	99.00%	99.00%	95.24%
97.03%	96.08%	99.15%	96.08%	97.55%	98.48%
95.14%	96.14%	99.52%	97.06%	98.04%	96.97%

Reading Accuracy without Pen 96.47% Std. Dev. 0.0128

Reading Accuracy with Pen 97.24% Std. Dev. 0.0145

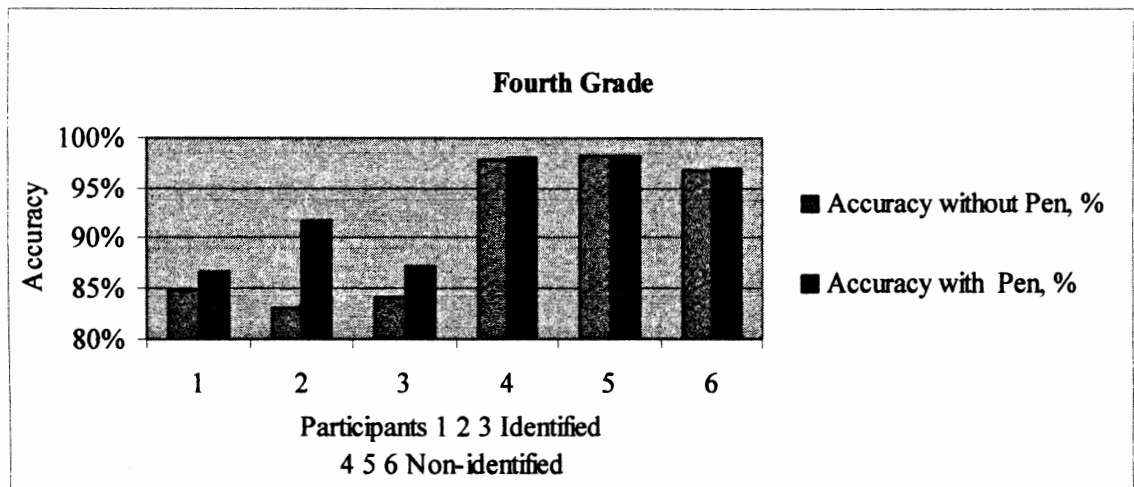
t - test = 1.479

Greater than 1.476 so within a 80% confidence interval we can say that the Reading Pen did increase the reading accuracy when looking at the third grade non-identified.

Table 3

Fourth Grade

As shown on Table 4, the fourth grade identified readers had an average of 84.08% without the Reading Pen and 88.93% with the Reading Pen, a statistically significant increase with a confidence level of 99%. The fourth grade non-identified readers had an average of 97.63% without the Reading Pen and 97.79% with the Reading Pen, a statistically insignificant increase. This group indicated that the Reading Pen had little effect when reading at a 95% accuracy level, but a very significant increase for the readers at an 85% or lower level.



Fourth Grade Accuracy Results - Identified					
Day 1 w/o Pen	Day 2 with Pen	Day 3 w/o Pen	Day 4 with Pen	Day 5 w/o Pen	Day 6 w/o Pen
83.85%	87.41%	91.85%	85.99%	90.45%	85.90%
86.21%	93.18%	96.02%	90.13%	95.39%	79.90%
86.51%	92.86%	93.65%	81.45%	87.90%	81.75%

Reading Accuracy without Pen 84.02% Std. Dev. 0.0271

Reading Accuracy with Pen 88.50% Std. Dev. 0.0449

t - test = 4.056

Greater than 4.032 so within a 99% confidence interval we can say that the Reading Pen did increase the reading accuracy when looking at the fourth grade identified.

Fourth Grade Accuracy Results - Non-identified					
Day 1 w/o Pen	Day 2 with Pen	Day 3 w/o Pen	Day 4 with Pen	Day 5 w/o Pen	Day 6 w/o Pen
98.42%	97.63%	100.00%	98.58%	99.29%	97.20%
98.15%	100.00%	99.21%	96.56%	97.94%	98.31%
97.39%	96.83%	98.94%	97.11%	99.17%	96.30%

Reading Accuracy without Pen 97.63% Std. Dev. 0.0082

Reading Accuracy with Pen 97.79% Std. Dev. 0.0130

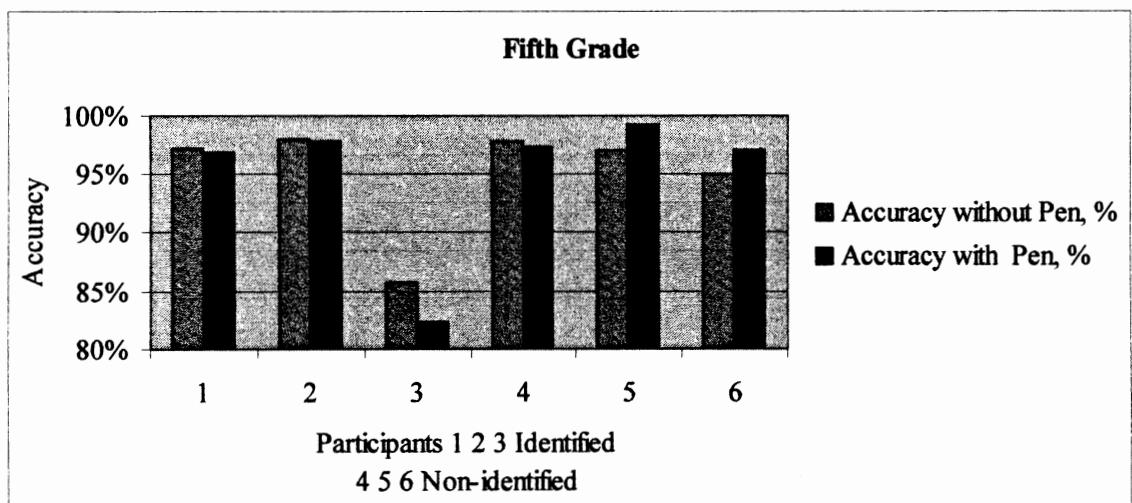
t - test = 0.476

Less than 1.476 so within a 80% confidence interval we cannot say that the Reading Pen did increase the reading accuracy when looking at the fourth grade non-identified.

Table 4

Fifth Grade

As shown on Table 5, the fifth grade identified readers had an average of 96.60% without the Reading Pen and 92.31% with the Reading Pen, a statistically insignificant decrease given high standard deviations. The fifth grade non-identified readers had an average of 96.60% without the Reading Pen and 97.87% with the Reading Pen, a statistically significant increase with a confidence level of 80%. This group indicated that the Reading Pen had a small positive effect when reading at a 95% accuracy level, but that variations in passages or other conditions that affect identified students can have a significant impact on the reading accuracy results. Please note the data for the third reader in Table 4, accuracy dropped from 91% on Day 1 to 82% on Day 2, jumped to 87% on Day 3 (reread of Day 2), return to 82% on Day 4, up again to 87% on Day 5 (reread of Day 4), only to end up at 80%. This had a very significant effect on the averages of the other two readers in this group, whose accuracy ranged from 95.5% to 100%. This deviation is well illustrated on the Fifth Grade graph in the Figure.



5th Grade Accuracy Results - Identified					
Day 1 w/o Pen	Day 2 with Pen	Day 3 w/o Pen	Day 4 with Pen	Day 5 w/o Pen	Day 6 w/o Pen
98.01%	97.49%	97.99%	96.32%	96.32%	96.26%
98.53%	100.00%	100.00%	95.52%	99.00%	97.31%
91.61%	82.35%	87.70%	82.16%	87.03%	79.89%

Reading Accuracy without Pen 93.60% Std. Dev. 0.0716

Reading Accuracy with Pen 92.31% Std. Dev. 0.0793

t - test = 0.442

Less than 1.476 so within a 80% confidence interval we cannot say that the reading pen did (or did not) increase (or decrease) the reading accuracy when looking at the 5th grade identified.

5th Grade Accuracy Results - Non-identified					
Day 1 w/o Pen	Day 2 with Pen	Day 3 w/o Pen	Day 4 with Pen	Day 5 w/o Pen	Day 6 w/o Pen
98.74%	96.97%	97.98%	97.63%	97.63%	96.88%
95.87%	99.53%	99.07%	98.95%	99.48%	98.15%
95.02%	96.96%	97.30%	97.20%	98.95%	94.94%

Reading Accuracy without Pen 96.60% Std. Dev. 0.0160

Reading Accuracy with Pen 97.87% Std. Dev. 0.0110

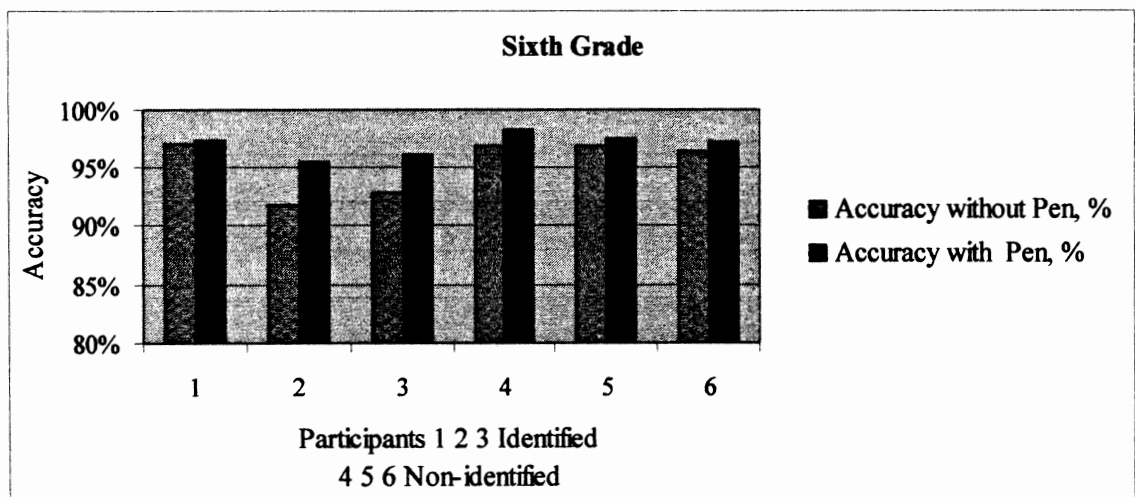
t - test = 1.951

Greater than 1.476 so within a 80% confidence interval we can say that the reading pen did increase the reading accuracy when looking at the 5th grade non-identified.

Table 5

Sixth Grade

As shown on Table 6, the sixth grade identified readers had an average of 93.90% without the Reading Pen and 96.35% with the Reading Pen, a statistically significant increase with a confidence level of 80%. The sixth grade non-identified readers had an average of 96.71% without the Reading Pen and 97.69% with the Reading Pen, a statistically significant increase with a confidence level of 99%. The high degree of confidence in the later group is due to a very low standard deviation. This group indicated that the Reading Pen did have a small positive effect when reading above a 95% accuracy level, and a significant increase for the readers at a 90% accuracy level. The effects evidenced in the fourth grade are further confirmed here, with the lowest initial reading accuracy having the largest increase. This group of students was also very enthused about using a new technology tool, and their enthusiasm likely resulted in a positive benefit, despite already high accuracy.



Sixth Grade Accuracy Results - Identified					
Day 1 w/o Pen	Day 2 with Pen	Day 3 w/o Pen	Day 4 with Pen	Day 5 w/o Pen	Day 6 w/o Pen
96.97%	98.09%	98.09%	96.73%	98.18%	97.20%
88.83%	96.53%	98.27%	94.61%	94.12%	94.59%
91.98%	96.72%	98.36%	95.41%	95.41%	93.85%

Reading Accuracy without Pen 93.90% Std. Dev. 0.0317

Reading Accuracy with Pen 96.35% Std. Dev. 0.0121

t - test = 1.892

Greater than 1.476 so within a 80% confidence interval we can say that the Reading Pen did increase the reading accuracy when looking at the sixth grade identified.

Sixth Grade Accuracy Results - Non-identified					
Day 1 w/o Pen	Day 2 with Pen	Day 3 w/o Pen	Day 4 with Pen	Day 5 w/o Pen	Day 6 w/o Pen
96.50%	96.80%	98.40%	100.00%	99.65%	97.24%
96.50%	97.26%	98.63%	97.92%	98.61%	97.28%
96.18%	95.20%	96.40%	99.29%	99.64%	96.55%

Reading Accuracy without Pen 96.71% Std. Dev. 0.0045

Reading Accuracy with Pen 97.69% Std. Dev. 0.0165

t - test = 5.366

Greater than 4.032 so within a 99% confidence interval we can say that the Reading Pen did increase the reading accuracy when looking at the sixth grade non-identified.

Table 6

DISCUSSION

Conclusions

This study indicates the Quicktionary Reading Pen has a positive effect on reading accuracy, most notable with students reading below a 90% accuracy level. The results suggest that readers who need the most help also gain the most benefit from the Reading Pen. This effect was most clearly identified in the fourth grade and sixth grade identified students increase in accuracy. The fourth grade identified group increased from 84.08% average accuracy without the Reading Pen to 88.93% average accuracy with the Reading Pen. This increase is statistically significant at the 99% confidence interval on a two sided *t*-test. The sixth grade identified group increased from 93.90% average accuracy without the Reading Pen to 96.35% average accuracy with the Reading Pen, representing a statistical significant increase at the 80% confidence interval on a two sided *t*-test.

A slight increase in accuracy of about 2% was noted when the students reread a passage. The increase in reading accuracy could represent long term retained memory for the words scanned. Another possibility is that the increase reflects familiarity with the passage. Further research is required to determine which of these two possibilities is occurring but the increase occurred for both passages that were reread. This is a positive result no matter what the mechanism.

The use of the Reading Pen showed a positive effect on reading accuracy at any reading level as the students showed enthusiasm for using the new technology. However, these effects could be related to the Hawthorne effect, or novelty effect, where the novelty of the technology may result in increased student effort and persistence (Balajthy,

1989). If the effects were the result of student enthusiasm, there would likely be diminished results over time. If the effects seen in the study were the result of the reading pen, the effects are more likely to remain consistent.

Recommendations

While this study achieved its purpose, further research is needed to confirm these conclusions. This study has identified additional parameters in order to optimize the accuracy and usefulness of further research. The first recommendation is to utilize reading samples that are at the frustration level rather than grade reading level to further identify the effectiveness of the Reading Pen. Due to the high reading accuracy, it was hard to determine the benefits derived from the Reading Pen. At the frustrational level, the lower reading accuracy should make the benefits of the Reading Pen more obvious and determine their statistical significance to a higher confidence level.

The second recommendation is to use larger sample sizes of identified readers to provide higher degrees of confidence given the larger variation in test data associated with these students. Because of the higher variability inherent in identified students, and the fact that testing was done at instructional level, the significance of the small increases in reading accuracy was lost in the large standard deviation of the sample. In two of the grades the average increases were greatly affected by the large variation of an individual student's performance. These individual variations would affect the averages less in a larger sample.

The last recommendation is to determine if use of the Reading Pen has any effect on reading comprehension. The apparent increase in reading skill does not necessarily

mean a corresponding increase in comprehension. The test methodology should carefully consider the effects noted in this paper in designing further testing for comprehension.

Summary

Twenty-four students participated in providing reading samples over a six day period to assess the effectiveness of the Quicktionary Reading Pen. The student instructional level was represented by six students from each grade level for third, fourth, fifth, and sixth grades. The student participants also represented equal numbers of those identified for special education reading and those from the general education classroom. Student reading levels varied from the third grade level to the ninth grade level.

Analysis of the reading accuracy from the samples lead to the conclusions that the Reading Pen statistically increased the reading accuracy for readers with an initial accuracy less than 90%, and appears to increase the reading accuracy for students enthused to use the Reading Pen technology. The Reading Pen appeared to have little effect for initial reading accuracy in excess of 95%.

The study also identified parameters for designing further research testing. Instructional level of reading for testing purposes resulted in relatively high accuracy and small changes in improvement for most of the students. Reading samples taken at the frustrational level of reading would likely indicate more substantial changes for use of the Reading Pen. For students identified for special education reading, larger sample sizes should be used because of larger reading sample variations, resulting in decreased levels of confidence in the results. The effect of the Reading Pen on comprehension should also be examined as part of future research.

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APPENDIX A

Percentile Values for Student's t Distribution with (n-1) Degrees of Freedom – two-sided				
Degrees of Freedom	Confidence Level			
	80%	90%	95%	99%
1	3.078	6.314	12.706	63.657
2	1.886	2.920	4.303	9.925
3	1.638	2.353	3.182	5.841
4	1.533	2.132	2.776	4.604
5	1.476	2.015	2.571	4.032
6	1.440	1.943	2.447	3.707
7	1.415	1.895	2.365	3.499
8	1.397	1.860	2.306	3.355
9	1.383	1.833	2.262	3.250
10	1.372	1.812	2.228	3.169
11	1.363	1.796	2.201	3.106
12	1.356	1.782	2.179	3.055
13	1.350	1.771	2.160	3.012
14	1.345	1.761	2.145	2.977
15	1.341	1.753	2.131	2.947
16	1.337	1.746	2.120	2.921
17	1.333	1.740	2.110	2.898
18	1.330	1.734	2.101	2.878
19	1.328	1.729	2.093	2.861
20	1.325	1.725	2.086	2.845
21	1.323	1.721	2.080	2.831
22	1.321	1.717	2.074	2.819
23	1.319	1.714	2.069	2.807
24	1.318	1.711	2.064	2.797
25	1.316	1.708	2.060	2.787
26	1.315	1.706	2.056	2.779
27	1.314	1.703	2.052	2.771
28	1.313	1.701	2.048	2.763
29	1.311	1.699	2.045	2.756
30	1.310	1.697	2.042	2.750
40	1.303	1.684	2.021	2.704
60	1.296	1.671	2.000	2.660
120	1.289	1.658	1.980	2.617
Infinity	1.282	1.645	1.960	2.576

Source: Adapted from Lapin (1990) Table G.

APPENDIX B

Story 10

Humpback Whale

Vocabulary

lured	attracted; tempted
destruction	crashing; breaking up; ruin
scarce	not enough; rare

In ancient times, sailors told tales of beautiful women called sirens, whose strange songs lured ships to destruction on rocky shores. Today, some scientists believe that those sailors heard the songs of the humpback whale. The voice of the humpback whale is like no other sound on earth. Some people hear a baby crying, and some hear a whole orchestra playing off key, while others hear groans, bleats, moos, rusty door hinges, or even a motorcycle starting up in these long, slow songs. No one knows how the humpback makes the sounds or why they make them. One guess is that the whales are sending each other messages through the sea.

The humpback has a round fin on its back that gives it a humpback look. It is a huge black whale, nearly 50 feet long. No two whales look quite alike, and no two have the same song. On its head and jaws and the edges of its flippers, the humpback has rows of bumps, each one with one or two coarse

bristles coming from it. No one knows what these bumps are for. The humpback's flippers can be as long as 18 feet, which is much longer than those of any other whale. They use their flippers to pat, rub, and hug each other. The humpback is one of the most playful animals in the world. It often leaps up and splashes down on its back or side, making a great noise. Sometimes it swims upside down or turns a huge somersault under water.

Once there were many humpbacks in the seas, but because they are slow swimmers and often swim close to shore, they are easy to kill and have been hunted for many years. To some people, these great beasts are nothing more than meat for dog food and oil for soap, paint, shoe polish, and cosmetics. Other kinds of meat and oil could be used just as easily for those purposes. As whales have grown scarce and as people have learned how intelligent and sensitive they are, most countries have stopped hunting them.

