Improved Reading Achievement by Students in the School District of Philadelphia who used Fast ForWord® Products During the 2004 - 2005 School Year

ABSTRACT

Purpose: This study investigated the effectiveness of using the Fast ForWord software within the curriculum in a school setting for improving the reading skills of academically low-performing students. **Study Design:** The design of the study is a multiple school study using standardized, nationally-normed independent tests of reading and language achievement. Dependent-sample t-tests were used to evaluate changes in student reading performance for all students who used Fast ForWord Products, and independent-sample t-tests were used to determine whether improvements varied by the quality of the Fast ForWord implementation and whether students who used Fast ForWord products had greater reading improvements than students who did not use Fast ForWord products. **Participants:** Study participants were students enrolled in the School District of Philadelphia, Pennsylvania who started using Fast ForWord products during the 2004-2005 school year and had test scores available for analysis. Students were primarily from the 3rd, 4th and 5th grades with a range of kindergarten through 12th grades. Reading skills were assessed four times at most schools: June 2004, November/December 2004, February/March 2005, and May 2005. Change in reading skills was examined for all students with test scores for before and after the school year, both by region and by the quality of the Fast ForWord implementation at the school. To examine the difference in improvements related to use of Fast ForWord products, two groups of students were identified: Fall 2004 Fast ForWord students, and Spring 2005 students. **Materials & Implementation:** Following staff training on the Fast ForWord products, Fast ForWord participants for the 2004-2005 school year, on average, used the Fast ForWord products for 35 school days. Student performance was evaluated by grade-equivalent scores on the Gates-MacGinitie Reading Tests for older students and reading levels on the Developmental Reading Assessment for younger students. **Results:** Three main results from the study were identified: **1) students using Fast ForWord products achieved significant gains of 12 months in reading achievement in 10 months; 2) larger score increases were associated with better Fast ForWord implementations; 3) students who used Fast ForWord products between assessments increased their scores significantly more than students who did not (9 versus 6 months of gains in 8 to 9 months of time).**

Keywords: Pennsylvania, elementary school, middle school, urban district, Fast ForWord Language, Fast ForWord Middle & High School, Fast ForWord Language to Reading, Fast ForWord to Reading 3, Gates-MacGinitie Reading Tests, Developmental Reading Assessment, implementation quality.

INTRODUCTION

Numerous research studies have shown that cognitive and oral language skills are under-developed in struggling readers, limiting their academic progress (Lyon, 1996). University-based research studies reported the development of a computer software product that focused on learning and cognitive skills, and provided an optimal learning environment for building the memory, attention, processing and sequencing skills critical for reading success (Merzenich et al., 1996; Tallal et al., 1996). This prototype of the Fast ForWord Language software showed that an optimal learning environment and focus on early reading and cognitive skills resulted in dramatic improvements in the auditory processing and language skills of school children who had specific language impairments (Merzenich et al, 1996; Tallal et al., 1996) or were experiencing academic reading failure (Miller et al., 1999). The School District of Philadelphia was interested in ongoing monitoring of the effectiveness of an optimal learning environment with a focus on early reading and cognitive skills as a way for improving reading achievement of low-performing students in a school setting. In this study, commercially available computer-based products (Fast ForWord Language, Fast ForWord Middle & High School, Fast ForWord Language to Reading, and Fast ForWord to Reading 3) were used to evaluate the effectiveness of an optimal learning environment with a focus on early reading and cognitive skills for improving the reading achievement of students.

METHODS
Participants
The School District of Philadelphia is divided into nine regions. For the purposes of this study, results were available from eight of the nine regions. For evaluating the impact of Fast ForWord products and the quality of the Fast ForWord implementation, all students for whom test scores were available and who began product use in the 2004 – 2005 school year were included. For comparing students who used products with those who did not, a subset of those students was examined: students who used the products prior to the mid-year assessment, and students who used the products after the mid-year assessment.

During the 2004 – 2005 school year, 2,851 students from 81 schools in Philadelphia, Pennsylvania started to use Fast ForWord products and had assessment data from at least one test administration reported for analysis. Grade level was not reported for all students. Of the 739 students whose grade level was reported and who had June 2004 scores for the Gates-MacGinitie Reading Test (GMRT), the average grade was 5.4, and the average reading grade-equivalent was 3.5, indicating a substantial skill deficit. Of the 922 students whose grade level was reported and who had June 2004 scores on the Developmental Reading Assessment (DRA), the average grade was 3.0 and the average reading level was 17.6. For reference, grade 3 students are expected to read in the 24 to 38 range (Fountas & Pinnell, 1999), well above the observed levels.

In order to evaluate the changes in reading skills of students who used Fast ForWord products relative to those who did not, two sub-groups of students were formed, based on when they began using Fast ForWord products. The Fall 2004 group, consisting of 428 students who had assessment data from June 2004 and February/March 2005, started using Fast ForWord products during Fall 2004, and used products for at least 5 days (242 students with GMRT scores, 186 students with DRA scores). The Spring 2005 group, consisting of 441 students who had assessment data from June 2004 and February/March 2005, did not start using Fast ForWord products until after the February/March 2005 assessment (190 students with GMRT scores, 251 students with DRA scores).

The Fall 2004 group was somewhat older, but both groups had similar reading deficits. Of the students whose grade was reported and who took the GMRT, the average grade and reading grade-equivalent were 5.5 and 3.7 for the Fall 2004 group and 5.0 and 3.5

for the Spring 2005 group. Of the students whose grade was reported and who took the DRA, the average grade and reading level were 3.2 and 19.8 for the Fall 2004 group and 2.5 and 13.1 for the Spring 2005 group. (For reference, grade 3 students are expected to read in the 24 to 38 range, grade 2 students in the 16 to 28 range.) This subset of students, then, was similarly low performing, compared to all students who started Fast ForWord products during the 2004 – 2005 school year.

Implementation
At each school, educators were trained in current and established findings on the neuroscience of how phonemic awareness and acoustic properties of speech impact rapid development of language and reading skills; the scientific background validating the efficacy of the products; methods for assessment of potential product participants; the selection of appropriate standardized language measures for testing and evaluation; effective implementation techniques; instruction on the product and on Progress Tracker, the reports generated by the product that allow educators and coaches to monitor student performance; and techniques for measuring the progress and gains students achieve after they have finished using the product.

The study took place during the 2004 – 2005 school year. Students were assessed four times: June 2004, November or December 2004, February or March 2005, and May 2005. Scores from the June 2004 and May 2005 administrations of the tests were compared for all students who used Fast ForWord products during the school year.

In addition, the quality of the Fast ForWord implementation at each school was assessed for all of these students and student gains from June 2004 to May 2005 were compared by school implementation quality. Good implementation quality consists of adherence to protocols by students (high participation, attendance, and content completion) and positive support of students using the products by the school (provision of well-functioning and orderly computer labs, monitoring of student progress with intervention when necessary).

Student scores from the June 2004 and February/March 2005 tests were compared for two groups of students: those who started using Fast ForWord products during Fall 2004, and those who did not use products until Spring 2005. The Fall 2004 group used Fast ForWord products between the June 2004 and February/March 2005 assessments, while the Spring 2005 group did not.

Materials
The Fast ForWord products, computer-based products combining an optimal learning environment with a focus on early reading and cognitive skills, were used in conjunction with the school curriculum. The products includes five to seven exercises designed to build skills that are critical for reading and learning, such as auditory processing, memory, attention, and language comprehension.

Circus Sequence[1], Sweeps[2], and Trog Walkers[3]: Students hear a series of short, non-verbal tones. Each tone represents a different fragment of the frequency spectrum used in spoken language. Students are asked to differentiate between these tones. The exercises improve working memory, sound processing speed, and sequencing skills.

Old MacDonald's Flying Farm[1] and Streams[2]: Students hear a single syllable that is repeated several times, and then interrupted by a different syllable. Students must respond when they hear a change in the syllable. This exercise improves auditory processing, develops phoneme discrimination, and increases sustained and focused attention.

Phoneme Identification[1], IDs[2], Polar Cop[3], and Treasure in the Tomb[3]: Students hear a target phoneme, and then must identify the identical phoneme when it is presented later. These exercises improve auditory discrimination skills, increase sound processing speed, improve working memory, and help students identify a specific phoneme. *Polar Cop* also develops sound-letter correspondence skills. *Treasure in the Tomb* also develops grapheme recognition.

Phonic Match[1], Matches[2], and Bug Out[3]: Students choose a square on a grid and hear a sound or word. Each sound or word has a match somewhere within the grid. The goal is to find each square's match and clear the grid. The *Phonic Match* exercise develops auditory word recognition and phoneme discrimination, improves working memory, and increases sound processing speed. The *Bug Out!* exercise develops skill with sound-letter correspondences as well as working memory.

Phonic Words[1] and Cards[2]: Students see two pictures representing words that differ only by the initial or final consonant (e.g., "face" versus "vase", or "tack" versus "tag"). When students hear one of the words, they must click the picture that matches the word. This exercise increases sound processing speed, improves auditory recognition of phonemes and words, and helps students gain an understanding of word meaning.

Language Comprehension Builder[1]: Students listen to a sentence that depicts action and complex relational themes. Students must match a picture representation with the sentence they just heard. This exercise develops oral language and listening comprehension, improves understanding of syntax and morphology, and improves rate of auditory processing.

Block Commander[1]: In Block Commander, a three-dimensional board is filled with familiar shapes that students select and manipulate. The students are asked to follow increasingly complex commands. This exercise increases listening comprehension, improves syntax, develops working memory, improves sound processing speed, and increases the ability to follow directions.

Stories[2] and Start-Up Stories[3]: Students follow increasingly complex commands, match pictures to sentences, and answer multiple-choice questions about stories that are presented aurally.

Scrap Cat[4]: In Scrap Cat, a series of words is visually presented and participants are asked to sort each word into the correct semantic, phonological, syntactic, or morphological category. For this exercise only, the participant can click a button to hear any word and see it defined. This exercise trains decoding, vocabulary, and word recognition skills.

Canine Crew[4]: In Canine Crew multiple words are presented together in a grid and participants are asked to find pairs that match on the basis of the current criterion. This criterion shifts from words that rhyme, to synonyms, to antonyms, to homophones, as the participant progresses. This exercise trains vocabulary, decoding, and automatic word recognition.

Chicken Dog[4]: Participants hear a word and see it partially spelled. They must complete the word by filling in the missing letter or letter group. Five options are always provided, including options that represent common visual and phonological errors. This exercise trains basic spelling patterns, letter-sound correspondences, and decoding.

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[1] Exercise from the Fast ForWord Language product.
[2] Exercise from the Fast ForWord Middle & High School product.
[3] Exercise from the Fast ForWord Language to Reading product.

[4] Exercise from the Fast ForWord to Reading 3 product.

Twisted Pictures[4]: Participants are presented with a variety of pictures and asked to select the sentence that most accurately describes each picture from among four alternatives. The descriptive sentences incorporate a wide range of syntactic structures. As the participant progresses, the sentences get longer and more difficult vocabulary is included. This exercise builds sentence comprehension by developing syntax, working memory, logical reasoning, and vocabulary.

Book Monkeys[4]: Participants read narrative and expository passages and answer comprehension questions about each passage. The multiple-choice questions demand that the participant use memory for literal detail, generation of inferences, or grasp of among four alternatives. This task develops paragraph comprehension, inferential and cause-and-effect reasoning, working memory, flexible reading, and vocabulary.

Hog Hat Zone[4]: In Hog Hat Zone, short passages from classic children's literature are presented, with occasional gaps in the text where words are missing. Participants are asked to fill in each gap with the correct word from among four alternatives. The missing words are morphologically important items such as pronouns, auxiliary verbs, and words with suffixes and prefixes. This task develops paragraph comprehension, complex morphology, flexible reading, and vocabulary.

Assessments
To evaluate reading achievement, schools in the School District of Philadelphia administered the Gates-MacGinitie Reading Tests (GMRT) to older students and the Developmental Reading Assessment (DRA) to younger students. Testing took place every few months, starting in June 2004. Many schools using Fast ForWord products reported students' GMRT grade-equivalent scores or DRA reading levels for analysis.

Gates-MacGinitie Reading Tests: There are two parts to the GMRT: a vocabulary test and a comprehension test. These tests are used to assess a child's decoding skills and understanding of words and passages. The scores from the two tests can be combined to give an overall reading score, that can be reported in terms of a grade-equivalent score.

Developmental Reading Assessment (DRA): The Developmental Reading Assessment provides teachers with a method for assessing and documenting primary students' development as readers over time within a literature-based instructional reading program. The DRA is designed to be used in K-3 classrooms with rich literate environments. The assessments are conducted during one-on-one reading conferences as children read specially selected assessment texts. A set of 20 stories, which increase in difficulty, are used for the assessment. The DRA evaluates two major aspects of reading: accuracy of oral reading and comprehension through reading and

retelling of narrative stories. Questions pertaining to concepts about print are also included in the assessment with lower leveled texts. DRA results can be recorded in terms of a letter or a number. For purposes of this evaluation, only numbers were used; all scores reported in terms of letters were converted into the appropriate number.

Analysis
Student achievement was reported in terms of grade-equivalents for the GMRT and reading levels for the DRA. Dependent-sample t-tests were used to see if students in each region improved their scores over time. Independent sample t-tests were used to evaluate whether gains were greater at schools with higher quality Fast ForWord implementations, and whether students who used Fast ForWord products between two assessments had greater gains than those who did not. The analyses used a p-value of 0.05 as the criterion for significance.

RESULTS
Participation Level of Students in the School District of Philadelphia
Of the 2,851 students who used Fast ForWord products, almost all used either the Language or Middle & High School product. After Language or Middle & High, 835 students went on to use the Language to Reading product, and 53 students used Language to Reading without prior product use, for a total of 888 using the Language to Reading product. The Reading 3 product was used by 170 students, mostly after a two product sequence of Language or Middle & High, followed by Language to Reading. There were 3,858 product starts in all.

Research conducted by Scientific Learning shows a relationship between product use and the benefits of the product. Product use is composed of content completed, days participated, and adherence to the chosen protocol (participation level and attendance). Most (78%) of the 3,858 product starts followed protocols that required 48 or 50 minutes a day, five days a week, for six to ten weeks. Another 12% of the product starts followed schedules of 75, 90 or 100 minutes per day, five days a week, for four to eight weeks and 10% of the product starts combined different protocols over the course of product use. Detailed product use information is shown in Table 1. Figures 1 - 4 show the average daily progress through the Fast ForWord product exercises for all product starts for all 2,851 students. The final day shown on each graph is determined by the maximum number of days that at least two-thirds of the students participated. For students who used the products fewer than the number of days shown, percent complete is maintained at the level achieved on their final day of product use.

Fast ForWord Software Products Used During 2004-2005 School Year	Number of Students	Average Days Participated	Average Calendar Days Participated	Average Overall Percent Complete	Average Participation Level	Average Attendance Level
Fast ForWord Language	2278	28.8	76.0	53%	90%	55%
Fast ForWord Language to Reading	888	18.9	50.6	41%	84%	57%
Fast ForWord Middle & High School	522	29.6	78.3	54%	79%	53%
Fast ForWord to Reading 3	170	14.7	42.8	32%	78%	57%

Table 1. For students starting Fast ForWord products during the 2004 – 2005 school year, participant usage showing the number of students who used each product, the average number of days they participated, the average number of calendar days between starting and finishing the product, the percent of content covered, the average participation level (the percent of protocol minutes spent on days student participated) and the average attendance level (the percentage of school days the students participated).
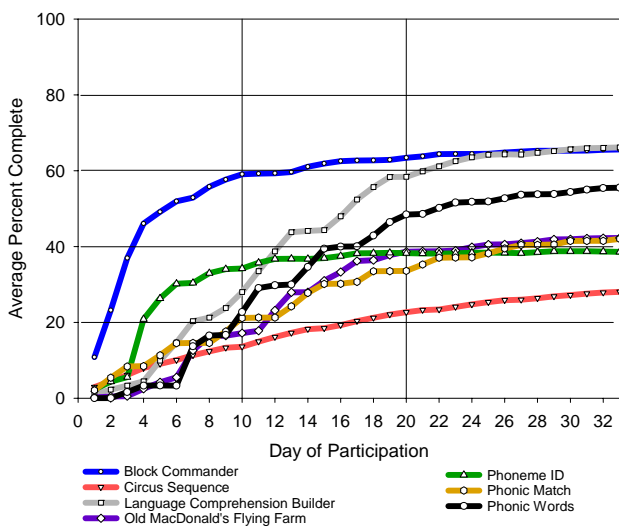

Figure 1. Average daily progress of students through the Fast ForWord Language exercises. Results from 2,278 students are shown.
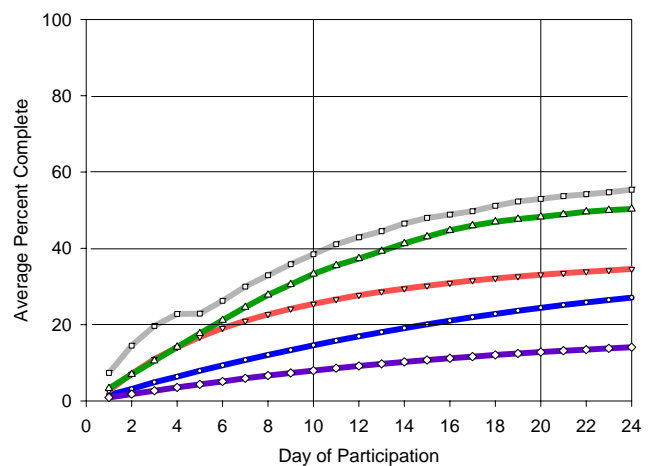

Figure 2. Average daily progress of students through the Fast ForWord Language to Reading exercises. Results from 888 students are shown.
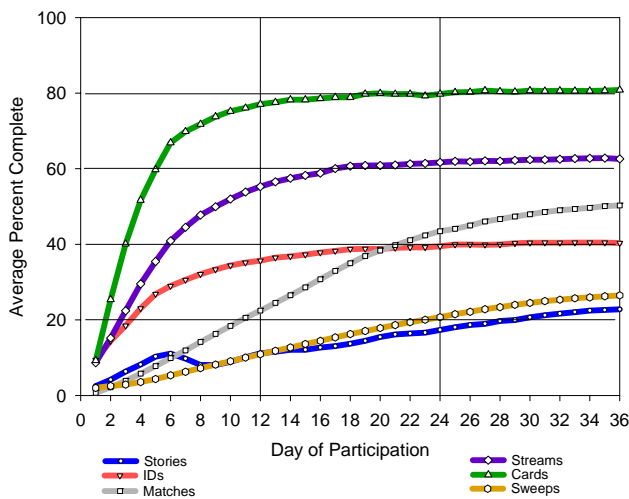

Figure 3. Average daily progress of students through the Fast ForWord Middle & High exercises. Results from 522 students are shown.
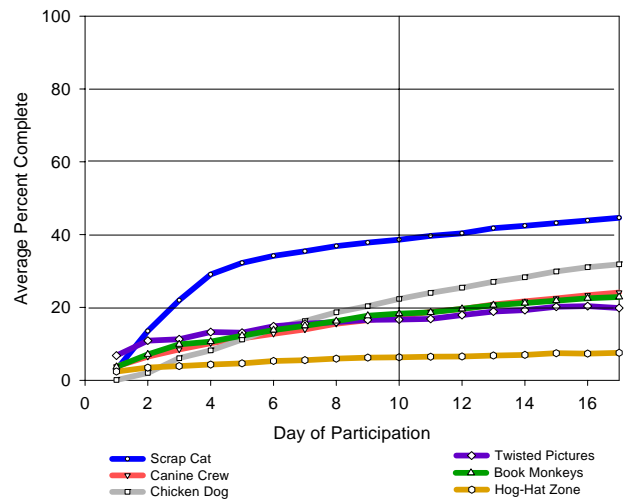

Figure 4. Average daily progress of students through the Fast ForWord Reading 3 exercises. Results from 170 students are shown.

| Region | Gates-MacGinitie Reading Test | | | | | | | Developmental Reading Assessment | | | | | | | |
| | June '04 | | May '05 | | Change | | | June '04 | | May '05 | | Change | | |
Region	n	Mean	SE	Mean	SE	Mean	SE	P	N	Mean	SE	Mean	SE	Mean	SE	P
SW	5	2.4	0.13	2.9	0.28	0.5	0.19	--	84	9.7	0.77	16.8	1.07	7.1	0.61	0.00*
S	131	4.4	0.15	5.5	0.18	1.1	0.12	0.00*	57	14.3	1.29	21.2	1.59	7.0	0.68	0.00*
CE	35	2.9	0.13	3.6	0.18	0.7	0.16	0.00*	97	11.5	0.97	19.6	1.26	8.2	0.53	0.00*
NE	280	3.7	0.07	4.6	0.09	0.9	0.06	0.00*	116	18.1	0.95	26.2	1.08	8.1	0.47	0.00*
N	68	2.9	0.06	3.6	0.09	0.7	0.09	0.00*	172	15.7	0.77	24.0	0.90	8.3	0.51	0.00*
E	122	3.2	0.08	4.1	0.09	0.9	0.08	0.00*	143	15.6	0.78	23.7	0.92	8.1	0.59	0.00*
C	--	--	--	--	--	--	--	--	16	14.8	1.12	23.0	1.99	8.3	1.70	0.00*
W	97	3.2	0.12	4.0	0.12	0.8	0.08	0.00*	129	19.9	0.88	28.6	0.88	8.7	0.53	0.00*
Total	738	3.5	0.05	4.5	0.06	0.9	0.04	0.00*	814	15.4	0.35	23.5	0.41	8.1	0.21	0.00*

*Table 2. Low-performing students using Fast ForWord products during the 2004 – 2005 school year made statistically significant gains from June 2004 to May 2005 on the Gates-MacGinitie Reading Tests and Developmental Reading Assessment in almost every region in the district. P-values not reported for comparisons with fewer than ten students. *p<0.05*

Assessment Results
Change Over Time

Of students with scores for June 2004 and May 2005 who used Fast ForWord products during the school year, 738 took the Gates-MacGinitie Reading Test and 814 took the Developmental Reading Assessment. A dependent-sample t-test finds that the change in average GMRT grade-equivalent from 3.5 to 4.5 is statistically significant (t=24.8, df=737, p=0.00), as is the change in average DRA level from 15.4 to 23.5 (t=37.9, df=813, p=0.00).

Change Over Time By Region

Table 2 shows average scores for June 2004 and May 2005, along with p-values for a dependent-sample t-test, for each region in the district. All regional changes were statistically significant (p<0.05). Significance tests were not performed for regions with fewer than ten students reporting June 2004 and May 2005 scores.

Change Over Time by Implementation Quality

Schools with good implementation quality have high adherence to product protocols and strong support from the school for students using Fast ForWord products. Protocol adherence includes high student attendance and participation, which allows students to complete a large portion of the product content. School-level support includes the provision of adequate computer lab resources, motiviation of students by teachers and staff, and monitoring of student progress with intervention

when necessary. Of the 738 students with GMRT results for June 2004 and May 2005 who used Fast ForWord products during the school year, 445 were at schools whose Fast ForWord implementations were judged to be good, and their average improvement was 1.0 years. The other 293 students were at schools with lower quality implementations or very recent implementations and they made average gains of only 0.8 years. The difference between gains for these two groups was statistically significant (t=2.85, df=736, p=0.01).

Of the 814 students with DRA results for June 2004 and May 2005 who used Fast ForWord products during the school year, 475 were at schools with good implementations and their average improvement was 8.5 levels. The other 339 students made average gains of 7.5 levels, a statistically significant difference (t=2.30, df=812, p=0.02).

Fast ForWord versus No Fast ForWord

A shorter span between tests – June 2004 to February/March 2005 – was evaluated in order to compare the gains of students who used Fast ForWord products between assessments to those who did not. On average, students who used the products between the two assessments made greater gains than students who did not begin Fast ForWord products until after the February/March 2005 assessment. Independent-sample t-tests found the difference in improvement to be statistically significant (see Table 3, Fig. 5 and 6).

Group	n	Gates-MacGinitie Reading Test							Developmental Reading Assessment						
		June '04		Feb/Mar '05		Change		Diff.		June '04		Feb/Mar '05		Change		Diff.
		Mean	SE	Mean	SE	Mean	SE	P	N	Mean	SE	Mean	SE	Mean	SE	P
Fall '04	242	3.8	0.09	4.5	0.11	0.7	0.08	0.02*	186	19.5	0.67	25.6	0.72	6.1	0.38	0.00*
Spring '05	190	3.5	0.09	4.0	0.10	0.5	0.06		251	12.8	0.58	17.3	0.62	4.4	0.31	

*Table 3. Low-performing students starting Fast ForWord products during Fall 2004 made significantly higher gains from June 2004 to February/March 2005 on the Gates-MacGinitie Reading Tests and Developmental Reading Assessment, compared to students who did not begin using Fast ForWord products until after the February/March 2005 assessment. *p<0.05*

DISCUSSION

Students from Kindergarten through 12th grade from all regions of the school district were represented in this study with 80% of the students from 2nd to 5th grades. Most of these students were far behind expectations for reading at their grade levels. With the use of Fast ForWord products, however, in ten months students achieved an average improvement of almost a year as measured by the Gates-MacGinitie Reading Test or eight reading levels as measured by the Developmental Reading Assessment, halting the trend these students had experienced of drifting ever farther away from grade-appropriate expectations. Even better results were found in schools where the implementation of the Fast ForWord products was of higher quality, indicating that students could benefit even more with increased attention at the school level to following Fast ForWord protocols.

Furthermore, a subset of students using Fast ForWord products achieved 0.7 years (approximately 9 months) of reading gains or six reading levels in eight to nine months, while a comparison group that did not use Fast ForWord products achieved only 0.5 years or four reading levels in the same period of time. It is important to note that the comparison group was formed of similar students – ones who were chosen as good candidates for Fast ForWord products, but who had not used the products by the time of the study. Previously, these students had not been mastering the academic material at the desired rate (one year in 12 months). Given the previous low achievement of these students, and their history of slow improvement, the students made impressive gains in their reading achievement. These improvements demonstrate that within the School District of Philadelphia, an optimal learning environment coupled with a focus on early reading and cognitive skills can have significant improvements on the reading achievement of students in elementary and middle school.
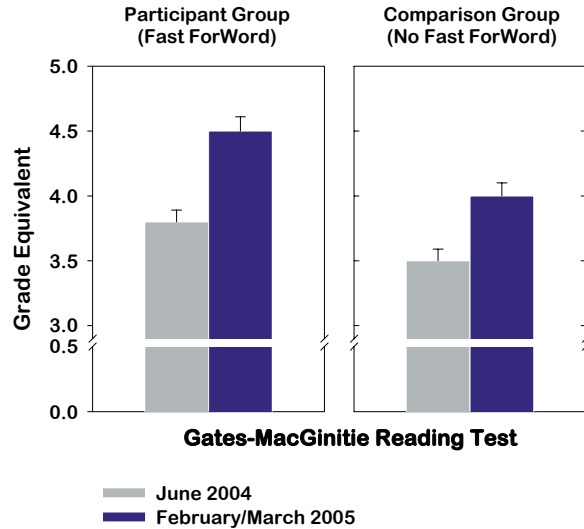

Figure 5. In eight to nine months, 242 students who started Fast ForWord products during Fall 2004 experienced significantly greater gains in reading achievement, as measured by the Gates-MacGinitie Reading Test, compared to 190 students who did not use Fast ForWord products during the period.
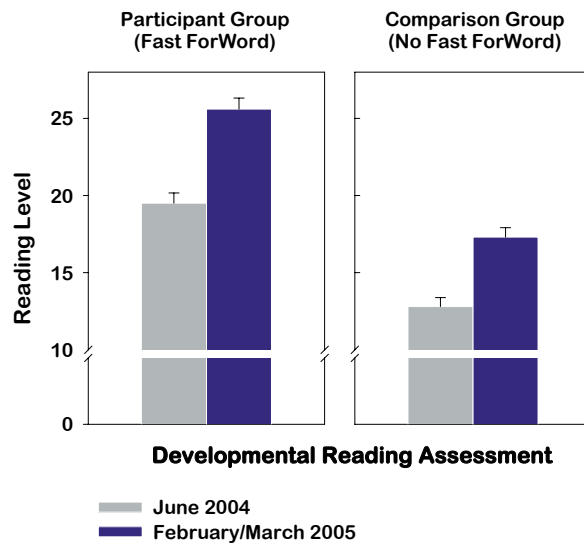

Figure 6. In eight to nine months, 186 students who started Fast ForWord products during Fall 2004 experienced significantly greater gains in reading achievement, as measured by the Developmental Reading Assessment, compared to 251 students who did not use Fast ForWord products during the period.

CONCLUSION

Low performing students made statistically significant gains in their reading development following the use of Fast ForWord software, and stronger gains than students who did not use Fast ForWord software during the period of comparison. These effects were experienced after an average of only 35 days of product use per student. The use of a comparison group and independent repeated measures of reading progress support the theory that these significant changes in K-12 student readers were due to the effects of combining classroom reading instruction with cognitive and language development software (Fast ForWord products).

These results replicate the University-based published research that demonstrates that the development of oral language and cognitive skills is linked to reading skills and allows students to be better positioned to be successful in the classroom curriculum.

Notes:

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