ALBUQUERQUE PUBLIC SCHOOLS

Fast ForWord Program Evaluation Plan

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BACKGROUND

In the 2010-2011 school year, the percentage of students rated Proficient or above on the New Mexico Standards Based Assessment (NMSBA) Reading test ranged from 45% to 55%, with only 15% to 20% of students with disabilities scoring Proficient or above. Notably, the percentage of students scoring Proficient does not increase with increased number of years in the school district. Students who are below Proficient in early elementary school continue struggling to catch up with their peers.

Fast ForWord Program

The *Fast ForWord (FFW)* program claims to close proficiency gaps by training a student's brain to attend to verbal information in a new way and thereby increase reading ability, phonological memory, and attention in the classroom. The *FFW* program is developed and marketed by the Scientific Learning Corporation. It uses a group of computer games that slow and magnify the acoustic changes within normal speech. With frequent repeated exposure to these magnified acoustic transitions, the expectation is that the phonological representations in one's brain are refined and an individual's phonological processing skills are sharpened. Each *FFW* product includes exercises designed to build cognitive skills such as attention, sequencing and memory, as well as academic skills critical for reading, such as English language conventions, phonemic awareness, vocabulary and comprehension (Scientific Learning Corporation, 2010).

Scientific Learning representatives contend that *FFW* is successful both as a catalyst for performance improvements in conjunction with other intervention programs, as well as on its own, as a stand-alone reading intervention program. They also contend that *FFW* improves performance in areas other than reading, such as math and classroom behavior, due to improvements in cognitive processing, memory and sequencing functions.

Studies exploring the effectiveness of *FFW* are numerous, but the results are variable, with school districts across the country claiming greater success from *FFW* than other programs, while some academic studies indicate that it is no better than regular instruction or other programs on the market.

Fast ForWord in APS

Six schools owned *Fast ForWord* licenses prior to 2011-12, and two of these schools (Mary Ann Binford Elementary and Manzano High) had used *FFW* with perceived success. In 2011-12, the APS Instruction and Accountability department upgraded and renewed all six *FFW* licenses with added professional development support. The intention was to create a coherent pilot *FFW* program that could be evaluated for potential replication and expansion.

Preliminary 2011-12 Evaluation Results

Fast ForWord was implemented to varying degrees of success in three APS schools, plus one pilot site, during the 2011-2012 school year. Evaluation results indicated that teachers were happy with student reading progress when *FFW* was implemented well. In particular, teachers noted changes in the following areas: increased participation in classroom activities; improved attention span; improved listening skills; improved pronunciation while reading out loud and improved ability to recall events in proper order.

Results from available student test scores were mixed. At one elementary school, students with good *FFW* implementation made strong gains on the NMSBA from Form 1 to 2, corresponding to the time frame students were using *FFW* products. However, on average across the three schools studied, students gained only half a grade level during the semester of use; gains ranged from a high of 2.4 years to a low of losing 1.2 years. Furthermore, correlations between measures of time on the product and gain scores were not significant.

Recommendations from the 2011-12 Evaluation

A primary difficulty in achieving good results from *FFW* was poor levels of implementation. According to standards set forth by Scientific Learning, students should use *FFW* products 30, 40 or 50 minutes per day, five times a week, for a minimum of 20 days. If students are not able to participate five days per week, the amount of time per day should increase to 90 minutes and the number of weeks that a student spends on the product also should increase.

Implementation barriers in 2011-12 included scheduling problems, poor teacher and student buy-in to the program, and insufficient time on *FFW* products. Recommendations to address these barriers were to:

- Schedule professional development with a Scientific Learning representative for all schools to take place at the start of the school year.
- Encourage all teachers using *FFW* to run through the program on their own.
- Extend demonstration time with students before starting them on the product.
- Increase available computer lab time.
- Designate a class period (that meets every day) devoted to *Fast ForWord* for a selected set of students.

Fast ForWord Implementation and Outcome Objectives for 2012-13

Four APS schools renewed *FFW* implementation at the start of the 2012-13 school year. Two additional schools acquired the remaining two *FFW* licenses in October 2012. Table 1 shows each school and the numbers of targeted students. Coordinators report that most students qualify for Special Education services.

Table 1. Students enrolled in FFW, fall 2013.

Manzano HS	Van Buren MS	M.A. Binford ES	Navajo ES	Edward Gonzales ES	Dolores Gonzales ES
202	**33**	**76**	**80**	**0**	**0**

Implementation objectives include:

- Students will complete a minimum of two *FFW* products during the school year.
- Each school will achieve a minimum implementation score of 65% Completion, 80% Attendance and 95% Participation, using 30, 40 or 50 minute protocols.

Among students meeting implementation standards, Scientific Learning anticipates the following learning outcomes:

- One to two-year learning gains, as measured by the Reading Progress Indicator (RPI).
- Students who were Nearing Proficient before *FFW* will achieve Proficiency, as measured by the NMSBA.

Implementation Monitoring and Continuous Quality Improvement

Because excellent implementation, with high participation levels, is necessary for fully evaluating the effects of *FFW*, APS' contract includes the following Scientific Learning services, valued at $53,900, for six schools:

- On-site instructional consulting consisting of:
    - Two to three visits per month per school between January and May, during which the Professional Development Manager will coach coordinators and teachers in practices of implementing, monitoring and getting results from *FFW*.
    - Two to four visits per school in August and/or September by the Professional Development Manager to help schools prepare for implementation in 2013-14.
- Remote Progress Monitoring, consisting of five telephone consultations and monthly emails with student data analyses and recommendations for enhancing results.
- Leadership consulting services consisting of up to two visits with principals at each school and/or with Instruction and Accountability personnel, to review student data, and discuss target groups, scheduling and other implementation issues.
- One day-long training in *FFW* for one or two representatives from each school (coordinators and/or teachers), which should result in plans for incentivizing student engagement and progress

APS' Instruction and Accountability division also will play an active and ongoing role in monitoring and reinforcing *FFW* implementation, which may include the following actions:

- Hold at least one full-day training session for coordinators, teachers and principals, which will address *FFW* implementation expectations and strategies and will clarify district support for flexible scheduling to meet *FFW* implementation protocols.

- Identify and publicize implementation successes so these may be acknowledged and celebrated by district leaders and school communities.

EVALUATION PLAN

Evaluation Sponsors and Stakeholders

The Executive Director of Instruction and Accountability is the primary sponsor of this evaluation. Stakeholders include school leaders, school coordinators, *FFW* teachers, *FFW* students and their families. Scientific Learning also has a stake in the success of APS' *FFW* program and its evaluation.

Evaluation Purpose

The primary purpose of the 2012-13 *Fast ForWord* Program Evaluation is to examine the effects of *FFW* as a catalyst and contributor to improved math and reading performance so that school and district leaders can make informed decisions about whether to continue and/or expand *FFW*, and how to maximize its effectiveness with APS students.

Evaluation Questions

The 2012-13 evaluation focuses on the following two questions:

1. How substantial and educationally significant are *FFW* contributions to students' math and reading performance?
2. What conditions, resources and activities facilitate successful implementation of *FFW*?
   a. How fully was *FFW* implemented, where and for how many students?
   b. What instructional consulting and progress monitoring services are offered by Scientific Learning advisors, and to what degree do school leaders and coordinators participate in those services and incorporate recommended strategies?

Evaluation Methods

a nested multi-level model and intent-to-treat design, using data from state and district assessments, will be used to measure *FFW* effects on reading and math performance. In addition, data from the *Reading Progress Indicator*, which is embedded in the *FFW* program, will be used to measure grade-level gains in reading. Finally, RDA may administer a survey to collect teacher perceptions of *FFW* impacts on student engagement, learning and behavior.

Table 2. Evaluation Indicators, Methods and Data Sources

Evaluation Question	Indicators	Methods/Data Sources
1. How substantial and educationally significant are *FFW* contributions to students' math and reading performance?	• Grade level gains on RPI • DRA2 & SBA gains • Correlations of implementation scores and gain scores • DBA progress compared to peer	Reading Progress Indicator (RPI) DRA2 (grades 1 & 2) DBA reading and math SBA reading and math
2. What conditions, resources and activities facilitate successful implementation of *FFW*?	• Amount of computer lab time allocated for *FFW* • Student participation in other reading intervention programs	• Computer lab schedules • Class schedules • Teacher survey
2.a. How fully was *FFW* implemented, where, and for how many students?	• Participants by grade & target group • *FFW* implementation scores • Percent students who complete at least two products[1]	*FFW* Progress Tracker
2.b. What instructional consulting and progress monitoring services are offered by Scientific Learning advisors? To what degree do school leaders and coordinators participate in those services and incorporate recommended strategies?	• Number of consulting sessions delivered at each site • Attendance at training and consulting sessions • Number of remote progress monitoring contacts per site • Topics/issues addressed at each site • Number of schools that incorporate recommended strategies	• Instructional consulting records (including staff attendance) • Remote Progress Monitoring reports and correspondence • Training attendance records

[1] A student is determined to to have "completed" *FFW* is he/she has trained for a minimum of 20 days (with 30 days preferred), has at least 70% completion on a majority of exercises (relaxed standard, with 90% preferred), and demonstrates steady progression in both sound and word exercises.

The following assessment sources will be used:

- *Reading Progress Indicator (RPI):* This is an assessment built into the *FFW* program and administered before and upon completion of each *FFW* product. It assesses a student's early reading skills, including phonemic awareness, decoding, vocabulary and reading and listening comprehension.
- *Developmental Reading Assessments (DRA2/EDL)* is a reading proficiency test administered to all 1st and 2nd grade students in English or Spanish, and also to some Kindergarten and 3rd through 5th grade students. The DRA2 is administered three times a year, in the fall, winter and spring.
- *District Benchmark Assessments (DBA)* is a criterion-referenced test that measures students' mastery of selected state standards at three points in time each year. Each assessment (Form 1, Form 2, and Form 3) contains content standards that reflect the content that has been taught in the classroom up to that point in time. A consistent performance band, such as Proficient, across the three assessment windows may indicate growth. In math, the DBA is administered to grades 1-12. In reading, the DBA is administered to grades 3 through 12 (for 3rd graders, schools may use the DRA2 instead of the DBA in reading).
- The New Mexico Standards Based Assessment (NMSBA) is a reading and math; state based assessment administered by the state of New Mexico once a year, for grades 3-8, 10 and 11.

Evaluation Design

To provide unambiguous estimates of *FFW* catalytic impact on students' academic progress, we use state and district standardized tests. Our hypothesized model will reveal any significant improvement in math and/or reading, directly attributed to *FFW*. Specifically, a student will on average be expected to gain a higher proficiency level in the district and/or state assessments, following exposure to *FFW*, for us to reject the null hypothesis. The null hypothesis states that *FFW* has no significant contribution to academic achievement.

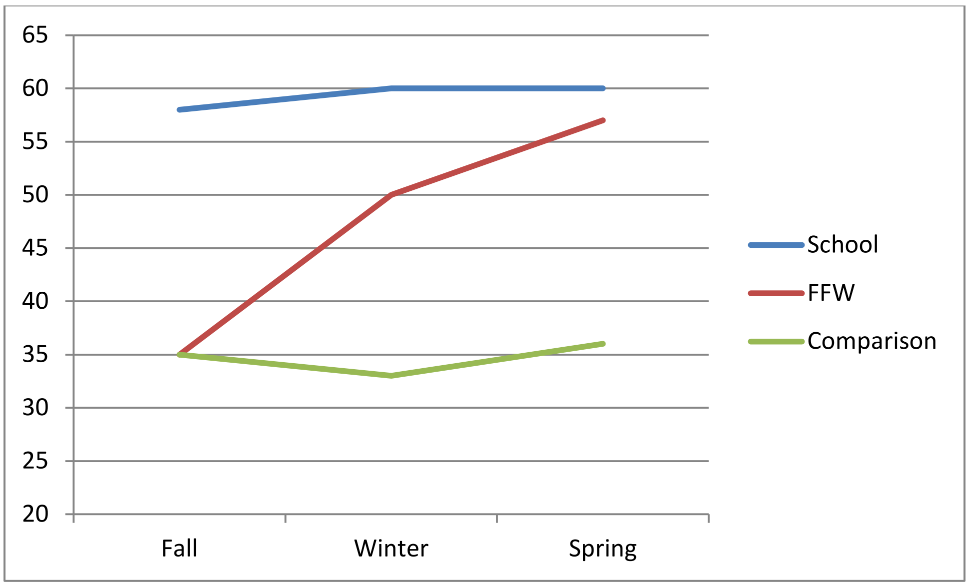
As noted previously, *FFW* is anticipated to impact math and reading performance in association with other intervention programs, rather than on its own. Therefore, the evaluations design will consider *FFW* as a secondary effect for reading performance, alongside another dominant reading intervention programs, such as Read 180. This evaluation design assumes that students on *FFW* are concurrently receiving a primary reading intervention program.

Comparison groups for each planned analysis will be matched in size and special education or ELL status. Analysis will be divided into two distinct groupings based on actual treatment. Researchers have advocated analyzing the entire sample of randomized subjects, regardless of the amount of exposure to the intervention (Ellenberg, 1996; Lachin, 2000; Torgerson & Torgerson, 2003; Little & Yau, 1996) called an intent-to-treat (ITT) design. These individuals have cautioned against analyzing a subset of a sample because of the risk of introducing potential bias or confounds. Based on these recommendations, this study will complete one analysis with the ITT group (unfiltered). The ITT group for the present study will be composed of all students who complete training on *FFW*, while on another reading program and also have both a RPI pretest and a RPI posttest. The second set of analyses will filter by *FFW* implementation score. Only students with implementation scores at 70 or above will be included in the analysis as part of the intervention group.

The design of the analysis for both filtered and unfiltered analyses will be a nested multilevel model. For grades one and two (combined into one analysis), the dependent variable will be the spring DRA2, predicted by group, student ELL status, fall DRA2 score, and student's *FFW* implementation score. A dummy variable representing an index of implementation level will be included to capture the school effects. Schools with a full time ELL teacher committed to *FFW* implementation gets assigned "1" and "0" otherwise. For grades four and five (combined), six through eight (combined), and nine through eleven (combined) the dependent variable will be the 2013 NMSBA reading score, predicted by group, student ELL status, 2012 NMSBA reading score, and student *FFW* implementation score. Nesting within school will only be necessary for students in elementary school since there is only one middle and one high school participating. We predict that students enrolled in the *FFW* program will make greater gains from fall to spring or previous year to current year than the control students. The results for ELL students may be weaker, in terms of effect size, than for the non-ELL students. Implementation scores should have a positive relationship with the spring reading score, accounting for the previous reading score, such that higher implementation scores result in better outcomes.

For the students who did not take the NMSBA, the DBA Form 3 in math and reading will be used as a proxy. DBA3 is offered in March, which provides sufficient time to allow for the impact of *FFW* to manifest. Students enrolled in *FFW* will have significantly lower DBA scores than their peers in the fall, but should start to close the gap over the course of the school year. A matched comparison group that is not utilizing *FFW* would not be expected to close the gap as readily (see example Graph 1). A repeated measures analysis will be completed to explore each group's progress over the three time points.

Figure 1. Example of anticipated DBA results.



To obtain a comprehensive evaluation of the *FFW*, it will be important to examine the program as a stand-alone reading intervention program. Scientific Learning, the program's publisher has made a claim that *FFW* can sufficiently be used as a primary reading intervention program, despite the fact that RDA's independent judgment designated *FFW* as a catalytical program, that builds phonological motor skills to enable a student to benefit from a conventional reading enhancing program. To obtain *FFW*'s net impact on reading improvement, this evaluation will conduct a double blind study with two groups of students; one group with students that are on *FFW* only and no other reading intervention program. The second group will be a control (placebo) group of students not receiving any type of reading intervention. Similar to the first part of evaluation design, student's test scores will be regressed upon other contributing factors such as ELL status, previous semester's scores, and *FFW* participation (or not), using binary response indicators. The estimated coefficient for *FFW* participation will need to be highly significant at the 95% confidence level, for the study to accept *FFW* as a suitable stand-alone program.

Empirical Model

According to William H. Green (2008), Nested multilevel data are critical in educational programs' (such as *FFW*) evaluations, since students may be nested within schools. In addition, hierarchically structured data tend to violate standard linear regression assumptions. Models for multilevel data have developed out of methods for analyzing experiments with random effects. In an ideal experiment, the analysis considers whether or not the presence or absence of one factor affects scores on an outcome variable i.e. does *FFW* improve reading capabilities when used alongside a primary intervention program? The categorical variables such as Special Education status, gender and English Language Learner (ELL) status in this evaluation are considered to be fixed because the same variable would be included in replications of the study.

In the present evaluation however, an implementation index that captures the school effect is not fixed and perfectly replicable across experiments. For example, different teachers or *FFW* administrators may administer the sessions to students. Usually the effect of a specific teacher is not of theoretical interest, but the evaluation would want to control for the possibility that an independent teacher effect is present beyond the fixed *FFW* effect being investigated. In such cases the evaluation will add a term to control for the random (implementation) effect.

Since our evaluation model now contain both fixed and random effects, we now have a basic mixed effects empirical model of the following form:

$$\gamma_{ij} = \mu + \alpha_j + \beta_k + (\alpha\beta)_{jk} + \varepsilon_{ij} \quad (1)$$

Here, the score on the dependent variable for individual *i* is equal to the grand mean of the sample (μ), the effect α of receiving treatment *j*, β which represents the k^{th} level of the random effect, $\alpha\beta$ which represents the interaction between random and fixed effects and an individual error term ε_{ij}. The constraint placed on the alphas is that the values sum to zero and the model is identified. In addition, it is assumed that the errors are independent and normally distributed with constant variance.

We proceed to test the hypothesis for the fixed effects, such that in the null, there are no differences in the means of each treatment group:

$$H_0: \mu_1 = \mu_2 = \ldots \mu_j$$

$$H_1: \mu_j \neq \mu_j \qquad (2)$$

In the random effects, the null hypothesis is that its variance equals to zero:

$$H_0: \sigma^2_\beta = 0$$

$$H_1: \sigma^2_\beta > 0 \qquad (3)$$

The justification of using a mixed model (with random effects) lies in the fact that the errors within each randomly sampled level-2 unit are likely correlated, necessitating the estimation of a random effects model. Once we have accounted for error non-independence, it is possible to make more accurate inferences about the mixed effects of interest.

We then proceed to state our general model in matrix format:

$$\gamma = \chi\beta + Z\mu + \epsilon \qquad (4)$$

Here, γ is a n x 1 vector of responses, χ is an n x p matrix containing the fixed effects regressors, β is a p x 1 vector of fixed effects parameters, Z is an n x q matrix of random effects regressors, μ is a q x 1 vector of random effects, and ϵ is an n x 1 vector of errors.

Model Estimation

An essential step to estimating multilevel models is the estimation of variance components. We therefore use the Full and Restricted Maximum Likelihood estimation (FML and REML). Both estimates produce identical fixed effects estimates. The latter, however, takes into account the degrees of freedom from the fixed effects and thus produces variance components estimates that are less biased. One downside to REML is that the likelihood ratio test cannot be used to compare two models with different fixed effects specifications. In small samples with balanced data, REML is generally preferable to ML because it is unbiased. In large samples, however, differences between estimates are negligible.

To evaluate *FFW* as a stand-alone program, a similar empirical model will be set-up for both study and control groups. The only difference is that we now have *FFW* participation as a stand-alone (not interacted with another program) as a binary independent variable. Model estimation and analysis will follow conventional statistical theory.

THEORETICAL BACKGROUND

It is well established that children struggling to learn to read have phonological processing difficulties. The cause for this poor phonological processing, however, is highly debated. One theory, original proposed by Paula Tallal, supposes that errant low-level auditory processing of dynamic signals in the speech stream disrupts typical phonological development in the brain. Based on her initial work with language impairment, Tallal (1980) tested children with reading impairments on temporal order judgment tasks of nonverbal auditory stimuli. In these tasks, two sounds play in succession with variable amounts of time between them and the participant's job is to determine which of two sounds came first. Tallal (1980) found that children with reading impairments had significantly more difficulty than normal readers on these tasks involving nonverbal auditory perception. The distinction was evident, however, only when stimuli were presented rapidly. For example, when two computer-generated non-speech tones were presented with short inter-stimulus intervals (ISI; 8-305 ms), children with reading disabilities had significantly more difficulty responding correctly than the control group, but these differences were not evident at longer ISIs (428 ms). Additionally, there was a high correlation between nonsense word reading errors and the number of errors on the auditory temporal processing task.

Based on these findings Tallal (1984) proposed that this temporal auditory processing deficit results in difficulty processing formant transitions in speech, therefore preventing children from analyzing speech at the phonemic level and correctly segmenting independent phonemes. Without the ability to perform phonemic segmentation the children would have difficulty learning to map graphemes onto phonemes, as is necessary for reading. Given the assumption that these deficits in auditory processing significantly affect the child's ability to acquire spoken language skills, Tallal and her colleagues developed remedial activities using acoustically modified speech. The speech was altered by expanding the rapid consonant transitions from 40 to 80 milliseconds and intensifying that part of the stimulus by 20 decibels. Researchers reported significant gains in language comprehension and expression through the use of this modified speech (Merzenich, Jenkins, Johnson, Scheiner, Miller, & Tallal, 1996; Tallal, et al., 1996), but other researchers have been unable to replicate Tallal's original findings (Mody, Studdert-Kennedy, & Brady, 1997), have been unable to find a relationship between auditory temporal processing deficits and reading ability (Marshall, Snowling, & Bailey, 2001; Bretherton & Holmes, 2003), or have found important mediating factors such as IQ, ADHD diagnosis, and processing speed (Bishop, Carlyon, Deeks, & Bishop, 1999; Stringer, 1998; Breier, Fletcher, & Foorman, 2003; Hulslander, et al., 2004).

Following Tallal's findings, the *Fast ForWord* (*FFW*) computer programs were developed to increase auditory processing skills in children with language or reading disabilities. The *FFW* programs attempt to retrain the brain to process information more effectively through a group of computer games that slow and magnify the acoustic changes within normal speech. With frequent repeated exposure to these magnified acoustic transitions, the expectation is that the phonological representations in one's brain are refined and an individual's phonological processing skills are sharpened.

Studies exploring the effectiveness of *FFW* are numerous, but the results are variable. Some randomized controlled studies have found that children receiving *FFW* training improved their language abilities (Gaab, Gabrieli, Deutsch, Tallal, & Temple, 2007; Stevens, Fanning, Coch, Sanders, & Neville, 2008; Tallal, et al., 1996), reading abilities (Gaab, et al., 2007), phonological awareness (Loeb, Gillam, Hoffman, Brandel, & Marquis, 2009), or neurological processing (Stevens, et al., 2008; Gaab, et al., 2007). Some studies only found effects for the children with the lowest academic or language skills (Troia, 2004). However, quite a few randomized controlled studies have failed to find evidence that training with *FFW* increases reading ability (Loeb, Gillam, Hoffman, Brandle, & Marquis, 2009; Borman, Benson, and Overman, 2009; Rouse and Krueger, 2004) or phonological awareness (Agnew, Dorn, and Eden, 2004; Troia, 2004). Additionally, studies that compared *FFW* to other interventions failed to find significant differences in student outcomes with other reading and phonological awareness products (Loeb, et al., 2009; Given, Wasserman, Chari, Beattie, and Eden, 2008; Pokorni, Worthington, & Jamison, 2004; Gillam, et al., 2008; Hook, Macaruso, and Jones, 2001).

An additional set of studies have been completed by Scientific Learning, the *FFW* publisher, with mixed levels of control. Uncontrolled studies measuring gains by students using the *FFW* software have found significant improvement in student phonological awareness (e.g., Scientific Learning Corporation, 2007) and reading (e.g., Scientific Learning Corporation, 2010) in elementary school, as well as high school (e.g., Scientific Learning Corporation, 2008). Controlled studies by Scientific Learning have also found significantly greater progress by students using *FFW* over controls in phonological awareness and reading (Scientific Learning Corporation, 2004a; 2004b; 2005). Finally, studies focusing on English Language Learners have also shown significant improvement in English language abilities following *FFW* program use (Scientific Learning Corporation, 2009; Scientific Learning Corporation, 2008).

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