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Evaluation of the Effectiveness of an Early Literacy Program for Students with Significant Developmental Disabilities Using Group Randomized Trial Research

Diane M. Browder

Lynn Ahlgrim-Delzell

Ginevra Courtade

Susan L. Gibbs

Claudia Flowers

Correspondence concerning this article should be addressed to Dr. Diane Browder, Department of Special Education and Child Development, University of North Carolina at Charlotte, 9201 University City Blvd, Charlotte, NC 28223. Contact information: 704-687-8836 (W), dbrowder@email.uncc.edu. Support for this research was provided in part by Grant No. H324K040004 of the U.S. Department of Education, Institute of Education Sciences, awarded to the University of North Carolina at Charlotte. The opinions expressed do not necessarily reflect the position or policy of the Department of Education, and no official endorsement should be inferred.

Abstract

The purpose of this study was to evaluate the impact of a curriculum called the Early Literacy Skills Builder (ELSB, Browder et al, 2007) on the language and early literacy skills of students with significant developmental disabilities using a randomized control group design. Students in the control group received the ongoing sight word and picture instruction prescribed by their IEP. Experimental students received a curriculum based on the National Reading Panel's components of reading. Results indicate statistically significant interaction effects for the treatment group for two research team designed measures of early literacy including the Nonverbal Literacy Assessment and a pre/post test for the experimental curriculum. Significant interaction effects were also found for two standardized measures (Peabody Picture Vocabulary Test III and Memory for Sentences of the Woodcock Language Proficiency Battery). Implications and future research needs are provided.

Evaluation of the Effectiveness of an Early Literacy Program for Students with Significant Developmental Disabilities Using Group Randomized Trial Research

For the last two decades, educators have placed strong emphasis on teaching students to read using scientifically based interventions. These interventions have been defined in research synthesis reports (Adams, 1990; National Institute for Literacy, 2001) and implemented through the Reading First Initiative. Together these reports provide converging evidence that learning to read is influenced by foundational, emergent literacy skills. The National Reading Panel (NRP, 2000) identified five essential components of reading instruction: (a) phonemic awareness, (b) phonics, (c) fluency, (d) vocabulary, and (e) comprehension. In comprehensive review of research on reading for students with significant developmental disabilities, Browder, Wakeman, Spooner, Ahlgrim-Delzell, and Algozzine (2006) found that the majority of studies for this population focused on sight word acquisition. Only a small portion of these studies targeted comprehension of these words.

Additional research also suggests that the "science of reading" that emerged in the last two decades bypassed students with significant intellectual and developmental disabilities[1]. Qualitative research including content analyses of textbooks (Katims, 2000) and ethnographic studies of children's school experiences (Kliewer, 1998) reveal a consistent lack of focus on reading for this population. This population is probably the least likely to learn to read without carefully planned, explicit instruction. In contrast, the evidence-based practices Browder et al., (2006) identified in their comprehensive review was the use of systematic prompting and feedback procedures during massed trials of sight words instruction (e.g., flash card drills). Many of these prompting procedures, such as time delay, promoted errorless learning through providing pre-response prompting that was

[1] The term "intellectual disability" is used instead of the term "mental retardation"; the term "developmental disability" is used to refer to the broader population of individuals with both intellectual disabilities and autism. This paper focuses on students with developmental disabilities at or below the moderate range of intellectual functioning.

systematically faded across teaching trials (e.g., by delaying the time before the prompt was introduced).

As noted by the NRP (2000), decoding skills, not just sight words, are essential to gaining competence as a reader. A few studies have taught phonics to students with moderate intellectual disabilities. Barudin and Hourcade (1990) and Lane and Critchfield (1998) found that students with moderate intellectual disabilities benefited from phonemic awareness training and phonics instruction. Hoogeveen, Smeets, and Lancioni (1989) and Hoogeveen, Smeets, and van der Houven (1987) also demonstrated positive outcomes when letter-sound correspondences were introduced to students with moderate intellectual disabilities. Bracey, Maggs, and Morath (1975) found that six of eight students with moderate intellectual disabilities made significant improvement in three reading skills: (a) reading sounds, (b) blending sounds into words, and (c) word reading. Two additional studies found that phonic analysis paired with error correction helped this population decrease word recognition errors (Singh, J. & Singh, 1985; Singh N. N. & Singh, 1988). Recently, Bradform, Shippen, Alberto, Houchins and Flores (2006) successfully used the *Corrective Reading Program* to teach decoding to middle school students with moderate intellectual disabilities.

A commonality in this research is that the students had the verbal skills to respond to instruction in the format typically used for phonics instruction. For example, they could articulate the initial consonant sound or say a word by blending sounds. In contrast, many students with significant developmental disabilities are either nonverbal or utilize augmentative communication systems even if verbal. Existing commercial programs do not provide guidance on how to adapt student responses for nonverbal learners. A second challenge is that this population often has language deficits that create a major challenge for developing meaning with printed text. For example, they may have limited picture identification and poor listening comprehension. While literacy programs developed for young children are available that promote language skills

concurrently with skills like phonemic awareness, these also lack guidance for nonverbal responders and those who need systematic prompting with multiple opportunities to respond to acquire new skills.

The purpose of this study was to develop and evaluate an early literacy program for students with significant disabilities that would be responsive to these communication challenges and address some compelling questions of literacy instruction for this population by adapting strategies that have been found effective for the nondisabled population (Ball & Blachman, 1991; Treiman & Baron, 1983). Specifically, the program was developed to include the NRP (2000) components of reading with attention given to the early literacy skills that built each of these components. In selecting instruments to measure change, it became apparent that most measures of early reading or early literacy also assume verbal ability. For this reason, our research also included the development of a standardized nonverbal assessment of early literacy. This report summarizes the findings and activities of the first year of a five year study on teaching reading to this population and focuses primarily on: (a) the development of the curriculum, (b) the development and selection of appropriate measures, and (c) the comparative effects of the curriculum versus a traditional sight word approach. Future questions to be addressed over the course of this longitudinal study are whether these skills considered essential building blocks for typically developing readers and adapted for students with significant disabilities will lead to fluent reading and if so, how long students will need to learn to read.

Method

The Development of the Curriculum

Research suggests that children entering first grade with phonemic awareness skills will experience more success in learning to read than their peers who enter first grade with little or no phonemic awareness (e.g., Hiebert & Pearson, 2000; Lyon, 1998; Perfetti, Beck, Bell & Hughes,

1997; Smith, Simmons & Kame'enui, 1998; Troia, 1999). In contrast, most students with significant developmental disabilities will need instruction to develop phonemic awareness in the elementary grades due to their developmental delay. The curriculum developed for the current study was based on the premise that it is not too late to begin promoting phonemic awareness skills for these students at ages 5-10 to promote the skills that can bridge to reading by late elementary school.

To develop the curriculum, the team reviewed research on early literacy (e.g., Neuman & Dickinson, 2002; Smith, Simmons, & Kameenui, 1998); existing early literacy programs (e.g., *Reading Mastery*, Englemann & Bruner, 1995; *Language for Learning*, Englemann & Osburn, 1999), and early literacy assessments (e.g., *DIBELS*, Dynamic Measurement Group, Inc, 2002; *TOPA 2*, Torgesen & Bryant, 2004; *TERA* 3, Reid, Hresko, & Hammill, 2001). From this review, a tentative list of instructional objectives and methods were developed and submitted to a panel of experts who had published in one of the following areas: (a) early literacy for typically developing students, (b) direct instruction reading for students with high incidence disabilities, (c) reading for students with significant disabilities, and (d) augmentative communication.

In June 2005, a panel of national experts in augmentative communication, early literacy, direct instruction, and progress monitoring participated in a full day discussion and provided subsequent written feedback on proposed and missing objectives and the planned instructional approach. Suggestions included in a revision of the curriculum were repeating skills across levels, adding the opportunity for writing, and including more print awareness. The recommendation to try embedding some of the skills in music was attempted, but not feasible. There was not consensus for some recommendations (e.g., whether concurrently teaching spelling and rhyming was essential) and these also were not followed.

The objectives were then developed into a scope and sequence chart with scripted lessons. The curriculum was entitled *The Early Literacy Skills Builder (ELSB,* Browder, Gibbs, Ahlgrim-Delzell,

Courtade, & Lee, 2007) and originally contained five levels with five lessons at each level. Each level introduced progressively more difficult skills. Some easier skills were dropped in higher levels and replaced by more difficult skills. For example, clapping out syllables in words was faded in Level 4 and replaced with clapping out letter sounds. The individual lessons within a level were built around particular stories about a frog named "Moe" giving students multiple opportunities to practice skills before moving on to more difficult ones.

The specific objectives of the ELSB are shown in Table 1 and will be briefly described here. The ELSB begins with a "sight word game" that is based on a constant time delay strategy (Collins, 2007). In the first round, the teacher prompts the correct response by pointing to the word as it is presented (zero delay). In the next round, a five second delay is used. For motivation, the puppet Moe "helps" the students as needed (used in prompting the correct response). The teacher then reads brief stories about Moe. To build text awareness, the teacher has the student assist with this reading by finding the missing word for a sentence or pointing to text read by the teacher. These skills are taught using the system of least prompts, a method of instruction that has been effective across a variety of skills with students with significant disabilities (Doyle, Wolery, Ault, & Gast, 1988). Using the Moe stories, the ELSB also promotes comprehension and vocabulary development through teaching students to answer literal comprehension questions after hearing brief passages read and to identify a variety of pictures that depict the same spoken word (e.g., pictures of "happy").

Because evidence suggests that phonemic awareness is strongly related to success in both reading and spelling (Ball & Blachman, 1991; Treiman & Baron, 1983), students are also taught blending and segmenting skills with direct instruction strategies (Carnine, Silbert, Kame'enui, & Tarver, 2004). Although phonemic awareness can be taught without visual referent through auditory training, Hohn and Ehri (1983), found that kindergarten students trained with letters learned to

segment better than those who used blank counters or no visual referent. The ELSB introduces letter sounds concurrent with printed letters and by using pictures as referents for blending so that students who are nonverbal or who need visual support (e.g., some students with autism) can demonstrate learning.

Given that most teachers of students with significant developmental disabilities have limited training in literacy, the decision was made to develop the ELSB as a scripted curriculum. Each lesson was written with suggested teacher script and suggestions for additional supports that could be used (e.g., ways to incorporate eye gazing, suggestions to enlarge materials). Although the suggested text may be used verbatim, suggestions are given to alter the script to accommodate students' needs (e.g., if more prompting is needed). The Moe stories were prepared for use on a story easel and student response cards were developed for each objective. These cards also could be adapted for use with an eye gaze board or voice output communication device.

Instrumentation

Nonverbal Literacy Assessment (NVLA)

After an exhaustive review of Mental Measurements Yearbook (MMYB) and Tests in Print, a general measure of literacy for students who were nonverbal could not be located. The NVLA was designed by the research team as a standardized measure of literacy since many of the participants would not be able to respond to the standardized administration procedures of the available literacy measures. Items for the NVLA were generated based on the five components of reading proposed by the NRP (2000) and by reviewing how these skills were measured in available literacy measures using verbal responses (e.g., *DIBELS*, Dynamic Measurement Group, Inc, 2002; *TOPA 2*, Torgesen & Bryant, 2004; *TERA* 3, Reid, Hresko, & Hammill, 2001). The NVLA uses a receptive response format with answers provided in 2-4 choice arrays. Four selection responses can be used in the standard administration including: (a) finger pointing with a response book, (b) eye gazing with

responses affixed to a plexiglass board, (c) pulling the response with cards attached with velcro to the response book, or (d) pulling the response with responses affixed to sticks displayed in the tester's hand like a fan. Correct verbal answers are also accepted when they occur.

The NVLA has scripted administration directions and is designed to be administered in three sessions to accommodate for attention difficulties and variability of responding frequently observed in this population. Due to the nature of the students who may require this nonverbal assessment, the administration time varied. For students who use the finger pointing response each session took approximately 20 minutes. For students who require the eye gaze system for responding, the administration time was longer due to the manipulation of the materials. The NVLA consists of 221 items that are divided into two sections, the Conventions of Reading (CVR) and Phonemic Skills (PhonSk). The CVR includes 41 items with skills such as book orientation, test pointing, turning pages, completing repeated story lines, listening comprehension, prediction, sequencing and identifying characters in the story. The PhonSk section includes 180 items with skills of word study (matching words, picture-word matching, sight words and reading vocabulary), alphabetic principal and beginning phonics (letter matching and identification, and letter sounds), breaking words into syllables, and phonemic awareness (identifying first and last letters of words, identifying first and last sounds of words, and identifying words with same and different first and last sounds) and blending sounds to form words. In this study, scores from the CVR, PhonSk, and a total score were used as dependent variables. A score for each section was calculated by summing the number of correct responses. A total score was calculated by summing the scores of the two sections.

To examine the stability of the NVLA, a test-retest study was conducted with 2 weeks between administrations. The test-retest reliability coefficient for the total test score of the NVLA was .97 ($p < .001$). Alpha coefficients for CVR, PhonSk and the total test, were .798, .972, and .979,

respectively. Fidelity of administration and inter-rater reliability of scoring the NVLA was conducted by a second observer recording the demonstration of proper administration procedures and scoring the student responses. The fidelity was calculated by an item-by-item agreement percentage. The mean fidelity of administration was 95.5% with a range of 93.1% to 98.5%. Inter-rater reliability was high at .96.

Content validity of the NVLA consisted of a review of the assessment items by a national panel of six experts in early literacy, severe disabilities and assessment. The panel agreed that items reflected the range of early literacy skills. Suggestions included renaming sections to better reflect the construct, adding verbal response sections, adding additional items, ensuring systematic use of distrators and establishment of basal and ceilings. Section names were changed with the assistance of another expert in literacy. Verbal response sections were not added given the availability of published assessments already accessible to students with verbal ability and because the NVLA was designed specifically for nonverbal responding. Use of distractors was applied in a systematic fashion from pictures/words pairs to words only and progressing difficulty of the distractor options from clearly wrong options (e. g., pictures/words of object options when asked to identify characters in the story) to finer discriminations (e.g., words beginning with b, p and h when asked to find the word that begins with the /d/ sound). Adding items and establishing a basal and ceiling were not addressed for this measure while in use for the research study, but is intended to be addressed as work on the instrument progresses.

Early Literacy Skills Assessment (ELSA)

The *Early Literacy Skills Assessment (ELSA)* was developed as pretest/posttest for the *ELSB* curriculum. It contained 152 items which were exactly matched to the skills taught in the experimental curriculum. Each of the nine sections of the ELSA corresponded to one of the nine

objectives of the ELSA curriculum. A score for each section was calculated by summing the number of correct responses. A total score was calculated by summing the scores of each section.

For this measure, studies of fidelity of administration, inter-rater reliability, test-retest reliability and internal reliability were conducted. The manner by which these statistics were calculated are the same as described in the NVLA. Mean fidelity of administration was 96.6% with a range of 91.2% to 98.9% and interrater reliability was 96.4% with a range of 92.5% to 99.2%. Test-retest reliability coefficients ranged from .689 to .797 and .763 for the total score. Internal reliability coefficients for the individual subtests ranged from .149 (4 items for literal questioning) to .980 and .896 for the total test.

PPVT III

The PPVT III (Dunn & Dunn, 1997) was administered as a standardized measure of receptive vocabulary for standard English with acceptable technical qualities. It was selected because it allows for participation of students who are nonverbal by pointing to a response. It provides two equivalent forms and one total test raw score. Words are orally given to the respondent by the examiner. The respondent points to a picture that best corresponds to the word. The total raw score is obtained by subtracting the number of errors from the numerical value of the ceiling item (highest word correctly identified). The raw score can be converted to a standard score, percentile rank, normal curve equivalent or age equivalent.

Technical adequacy of the PPVT III is documented by the test publisher in the Examiner's manual (Dunn & Dunn, 1997). For the ages included in this study, internal consistency, as measured with coefficient alpha, ranged from .93 to .95. Split-half coefficients ranged from .86 to .95. Alternate forms reliability coefficients for raw scores ranged from .92 to .95 and corrected test-retest reliability coefficients ranged from .93 to .94 for the ages included in this study.

Evidence of validity of scores from the PPVT-III was examined by correlating the PPVT-III scores with other measures of reading (Dunn & Dunn, 1997). The PPVT III had an average correlation of .70 with the OWLS Listening Comprehension scale and .67 with the OWLS Oral Expression scale. Its correlations with measures of verbal ability are: .91 (WISC-III VIQ), .87 (KAIT Crystallized IQ), and .82 (K-BIT Vocabulary). The Technical References supplement compares PPVT-III scores of eight special populations (speech impaired, language delayed, language impaired, intellectual disabilities [child and adult], reading disabled, hearing impaired, and gifted) with demographically matched control groups (Pearson's Assessments, n. d.) http://ags.pearsonassessments.com/group.asp?nGroupInfoID=a12010).

WLPB

The Woodcock Language Proficiency Battery (WLPB, 1991) is comprised of 13 subtests in the areas of oral language, reading and written language. The manual indicates that this instrument may be used to "determine and describe the status of and individual's language" in these three areas. Raw scores, described below for each subtest, can be converted to age/grade equivalents, W score, standard score, percentile rank or Relative Mastery Index (RMI). Due to the verbal language requirement for responding to test items, only two subtests were used in this study, Memory for Sentences and Letter Word Identification. Raw scores were used in this study.

Technical adequacy of the WLBP is reported in the Examiner's Manual. Internal consistency, as measured with coefficient alpha ranges from .81 to .96 for the subtests used in this study across ages 6 and 9. Test stability as measured by readministering the subtest to individuals with between 1 to 17 months between testing sessions. These coefficients for the subtests used in this study range from .78 and .94.

Evidence of validity was examined by correlating the WLPB with other measures of reading. Concurrent validities of basic reading skills for grades 3 and 4 was .84 with the PIAT, .79 with the

K-ABC, .82 with the K-TEA, and .85 with the WRAT-R Level 1. Construct validity was conducted by examining subtest intercorrelations at selected ages and patterns of score differences for subjects from selected populations. Subtest intercorrelations for the subtests used in this study for ages 6 and 9 ranged from .27 for passage comprehension and listening comprehension at age 6 and .33 for word-attack and listening comprehension at age 4 to .80 for both word attack and letter-word identification at age 3 and .letter-word identification and passage comprehension at age 4. The means and standard deviations of scores across 4 comparison groups of gifted, typically developing, learning disabled, and mentally retarded for skill clusters are reported.

Each subtest provides standardized administration procedures. In Memory for Sentences the respondent is given words and phrases of increasing difficulty to repeat verbatim. A score of 0, 1, or 2 is given dependent upon the accuracy of the oral repetition given by the respondent. This subtest was selected as a standardized measure of oral language. Letter-Word Identification is comprised of three sets of responses. In the beginning items the respondent is to match one of three black and white drawn rebus symbols to a larger, color picture of the intended object. A respondent points to the correct rebus symbol. Later the respondent is asked to read individual letters and then words of increasing difficulty. A score of 0 or 1 is given depending upon the accuracy of the response. This subtest was selected as a standardized reading measure. Information on subtests not included in this study can be found the in WLPB Administration Manual.

Intervention Study

The study utilized a randomized control group design. Students were randomly assigned into either a treatment or control group. All participants were pretested at the beginning of the academic year before treatment was implemented and posttested at the end of the school year. The following sections describe the participants and setting, method of random assignment of participants, instrumentation, dependent and independent variables, and analytic techniques.

Inclusion Criteria

Seven self-nominated special education teachers in three disability areas, severe/profound intellectual disabilities, moderate intellectual disabilities, and autism, in a large urban school district in the southeast United States volunteered to participate in the study. These seven teachers identified students who they believed met the eligibility criteria that included the following: a) IQ 55 or below with comparable deficits in adaptive behavior (if no IQ score could be obtained, developmental screening reflected severe deficits in intellectual functioning), b) enrolled in grades K-4, c) reading below 1st grade level, d) adequate hearing and vision to respond to curricular materials and instruction, responsive to ongoing instruction in English if ESL, and f) parental informed consent to participate in the research. From the initial pool of 35 teacher-nominated students, 24 met the criteria for inclusion in the study, but one only attended school a few days the first months and so was dropped.

Description of Participants

The 23 student participants were enrolled in grades K through 5 and attended school in self-contained special education classrooms. IQ scores were obtained for 19 of the 23 participants from school records. These scores were derived from a number of different psychological tests, some of which only provided a mental age equivalent. In cases where a mental age equivalent was provided in place of an IQ score, a deviation IQ was calculated by dividing the mental age by the chronological age and then multiplying by 100. Deviation IQs below 20 and reports containing notations of "IQ below 20" were recorded as "20" in the database. Therefore, the obtained mean IQ is somewhat less than the true mean IQ. The estimated mean IQ for the total group of students was 41 with a standard deviation of 12.67 and a range from below 20 to 54. Six students were included in general education classes ranging from 30 minutes to 7 hours per week. All the participants had estimated intellectual disabilities in the moderate to severe/profound range,

although many could not participate in traditional testing due to restricted verbal and behavioral repertoires. None of the students qualified for English as A Second Language, six qualified for the free lunch program. A description of student participants by group assignment is reported in Table 2. Chi-square analyses indicate no statistically significant differences ($p > .05$) between the control and treatment group for gender, ethnicity, verbal status, grade, lunch status and classroom type. T-test analyses indicate no statistically significant differences ($p > .05$) between the control and treatment group for IQ and age. Comparison of group differences at pre-test found no significant differences between the groups on any of the dependent variables.

The seven teachers, who administered the control and treatment intervention, were all self-contained, elementary school special education teachers with an average of 8.83 years teaching and 8.67 teaching special education with a range of 1 to 19 years. One teacher taught general education for one year before teaching special education. Four teachers held a Bachelor's degree and 3 held a Master's degree. Five teachers had a regular special education teaching license and 2 had a provisional entry license. One teacher also had a general education teaching license. Six of the teachers were White and one was Hispanic.

Random Assignment of Students

To help control for a teacher effect, half of the students in each classroom were selected for the treatment group and the other half as the control group. Names of all the eligible students in each classroom were written on pieces of paper and placed into a box; without looking into the box the teachers pulled the predetermined number (e. g., half) of the names from the box to form the treatment group within her own class. The remaining names in the box formed the control group. In the case of an uneven number of students in a classroom, the number of students in the disability group across classrooms (there were at least two classrooms per disability type) was used to divide the number of students in half. The teacher within the disability group with the smallest number of

students randomly selected an extra student for the treatment group and the paired teacher of the same disability type with the larger number of students selected one less treatment student. This resulted in 12 students in each group at the initial selection. A student with absentee problems was dropped from the treatment group leaving 11 treatment students.

This simple sampling method was chosen because it was feasible to the logistics of the applied context. Further matching by type of disability or level of functioning was not feasible given the small sample size. Because of the small sample sizes in each group, statistical tests for examining mean differences between the treatment and control groups on the pretest measures were conducted. Initial statistical analyses indicated that treatment and control groups were equivalent for all pretest measures. Additional details of these analyses are presented in the results section.

Dependent Variables

The dependent variables in this study included the two measures created by the research team, the Nonverbal Literacy Assessment (NVLA) and the Early Literacy Skills Assessment (ELSA). Two standardized language measures, the Peabody Picture Vocabulary Test III (PPVT III, Dunn & Dunn, 1997) and two subtests of the Woodcock Language Proficiency Battery (WLPB, Woodcock, 1991) were also used following the standardized procedures. The two subtests selected for this study included Memory for Sentences and Letter-Word Identification. For all the measures raw scores were used in this study.

Intervention

The independent variable in this study was the type of reading instruction. All reading instruction was conducted by the classroom teachers after workshops in which they received training on implementation. Teachers also received ongoing classroom consultation to ensure ongoing procedural fidelity.

Shared Intervention. As noted earlier, students with significant developmental disabilities often receive minimal literacy instruction. Prior to introducing the experimental curriculum, the decision was made to ensure that all students in the study were receiving a foundational level of literacy instruction through shared stories which we called story-based lessons (SBL). To develop literacy, children need exposure to literature including both narrative and expository works (Morrow & Gambrell, 2002). Children who are read to daily tend to score higher on measures of vocabulary, comprehension, and decoding (Bus, van Ijzendoorn, & Pellegrini, 1995; Senechal, Thomas, & Monker, 1995). The primary purpose of this read aloud event is the construction of meaning from the interactive event between the adult and child (Vygotsky, 1978). Consistent exposure to read alouds contribute to improved comprehension and vocabulary development (Vacca, et al., 2006).

Teachers selected grade-appropriate literature from a variety of means including a list of recommended reading lists accompanying the Open Court reading program used by the school district and discussions with general education teachers. Selected books were adapted to accommodate student access as needed for physical challenges, text length, and pictures to support comprehension of text. A ten-step task analysis of engaging students in the reading and comprehension of the book was developed for teachers that included (a) anticipatory set, (b) opening the book, (c) turning pages, (d) identifying author and (e) title, (f) completing a repeated story line, (g) pointing to text, (h) answering a prediction question, (i) pointing to/saying vocabulary word and (j) answering comprehension questions.

Because the participating teachers had limited training in literacy, the research team provided a specific template for sharing stories (task analysis of steps to follow) that would engage the students in the reading of the books and answering questions about the story. In the first full day training event held in November, research team members demonstrated the steps of the task analysis then teachers practiced following this task analysis with each other until fluent. Methods for

adapting grade-appropriate literature were described and examples of different adaptations were provided. Although teachers selected and adapted their own books for the shared stories, they received ongoing observations and feedback on their fidelity on following the task analysis to the shared story approach. A total of 55 observations of story-based lessons were conducted across the 7 teachers. Teachers typically shared stories with their entire class, or a small group in the class, including students in both the experimental and control groups. Teachers conducted story-based lessons with the students throughout the school year from early November to early June. The researchers interviewed the teachers to ensure that both groups received comparable time in shared stories (daily except during special events). Additional information regarding time spent in story-based lessons and teacher fidelity is provided in the results section.

Experimental Group-ELSB. The teachers received the scripted ELSB curriculum including teacher directions, student response materials, the story easel and training on each objective of the curriculum in mid October. Researchers demonstrated following the script, prompting and error correction procedures for each objective then teachers practiced each objective with each other until fluent during a second full day training event. They then received ongoing classroom observations using a task analysis of teacher and student behaviors for each objective and given feedback on maintaining fidelity with the objectives. A total of 58 observations of the ELSB were conducted across the 7 teachers from October to May. Teachers implemented the ELSB either 1:1 or in a small group of 2-4 students depending on the number of students in their class randomly assigned to this intervention. Teachers could choose to repeat each lesson on a 2, 4, or 10 day cycle depending on the pace of the group. Students did not move to the next level until they had 75% correct responding on the lessons in the prior level. This criterion was based on data taken by a member of the research team while the teacher implemented the lesson. If an individual student's performance was slower than a group, he or she received additional practice to catch up deficient skills or a

separate lesson. Teachers delivered ELSB lessons to students throughout the school year from mid October to late May. Additional information regarding time spent in ELSB lessons and teacher fidelity of instruction is provided in the results section.

Control Group-Sight Words and Pictures. Students in the control group received sight word or picture instruction using a commercial sight word curriculum (Edmark, Austin & Boekman, 1990) or sight words and pictures that related to the students' needs and preferences. Edmark uses a whole word approach to learning to read words in software and print versions. Many of the teachers in the study had this program available in their classrooms prior to implementation of the intervention. In fact, in all cases the sight word and picture training implemented for the control students was the ongoing intervention prescribed by the students' IEP. The amount of time these students spent in sight word training was tracked, but the number and type of sight words and picture instruction these student received were not recorded because of the variation across students. The sight word lessons were also implemented in either a 1:1 or small group format depending on the number of students assigned to this condition in the classroom.

Analytic Techniques

A series of mixed analyses of variances (ANOVAs) with one between and one within subjects factors were conducted to determine differences between the treatment and control groups on the eight outcome measures. For all ANOVAs, the between subjects factor consisted of the instructional type, treatment and control interventions. The within subjects factor consisted of the repeated measures obtained from participants across the school year. Because the primary purpose of this study was to examine a differential effect between the treatment and control groups, the statistical tests of interest were the interaction terms. In other words, it was hypothesized that the students in the treatment group would have greater gains (i.e., greater mean differences from pretest to posttest) than the gains of the control group resulting in an interaction.

Multivariate analyses were not conducted because of an insufficient sample sizes. No attempt was made to adjust for conducting multiple univarate statistical tests. The statistical power based on the small sample sizes suggested that statistical significance would only be found for large effect sizes. Adjusting for multiple statistical tests using a Bonferroni correction would have decreased the statistical power to an unacceptable level. Since *a priori* hypotheses were stated, one-tailed statistical tests were conducted, which increased the statistical power. Because of the challenges in applying statistical tests to a low incidence population, including the small sample size and large individual variance more emphasis should be place on interpreting the effect sizes.

Results

All 11 students in the treatment group progressed through at least one level of the five level curriculum by the end of the academic year. Six students had progressed to level 2, 3 students had progressed to level 3, one student had progressed to level 4 and one student completed all 5 levels.

Instructional Time and Treatment Diffusion

Every two weeks, teachers reported the amount of instructional time and types of literacy skills included in the instruction for the preceding day. This resulted in approximately 10 reports. Table 3 provides the mean and range minutes per day of literacy instruction for the ELSB, story-based lessons (SBL), sight word/picture instruction, other phonics instruction and other literacy instruction. The most common "other" literacy instruction was extra group instruction learning days of the week and months of the year, weather words and daily schedule words. Both treatment and control group participants received equal time in literacy instruction, approximately 1 hour per day. Because the Edmark or other sight word instruction was shorter than the ELSB, to give control students comparable time in literacy instruction per day, teachers augmented sight word drills with other types of literacy skill instruction. No control students received the ELSB, but one did

inadvertently receive some exposure to a computerized phonics program. There were no significant differences between the groups in time spent in literacy instruction.

Teacher Fidelity of Instruction

Both experimental and control groups received shared stories and the mean fidelity for following the prescribed template was 85% of the steps implemented with a range of 30% to 100% across 55 observations of all seven teachers (lower scores occurred early in intervention). A second observer concurrently and independently observed about a third of these lessons. The mean interrater reliability for the story fidelity measure was 94.9% with a range of 80 to 100%. The mean fidelity for the ELSB was 93% with a range of 53% to 98% across 58 observations of all the teachers and interrater reliability for this fidelity was 93.5% with a range of 89% to 97%. Fidelity for the control group's sight words intervention was not feasible due to the diversity of methods the teachers employed. Instead, the researcher focused on comparability of instructional time.

ANOVA Results

Prior to running the ANOVAs, the dependent variables were examined for accuracy of data entry, outliers, missing values, normality of distribution and other assumptions of ANOVA. All values were within acceptable ranges and the assumptions were tenable. The first series of ANOVAs examined the group interaction effects on the researcher team designed measures of literacy, *NVLA* total score, Conventions of Reading (CVR), Phonemic Skills (PhonSk), and *ELSA*. The means, standard deviations, and effect sizes for the control and treatment groups are reported in Table 3. The effect sizes were Cohen's *d* based on a pooled standard deviation and indicate the magnitude of differences between the pretest and posttest for each group. There were large effect sizes for all the measures of the treatment group, ranging from 1.15 to 1.57. The effect sizes for the control group were small (.39) to moderate (.65) except to CVR, which was quite large, 1.24. This was not surprising since both groups received the shared stories intervention.

The results of the mixed ANOVAs are reported in Table 4. Box's tests of equality of covariance matrices were not significant for all analyses suggesting equal satisfying the assumption of equivalent covariance matrices. The statistical tests of interest to determine non-parallel control and treatment slopes are the interaction effects. Three of the four interaction effects were statistically significant, NVLA total score, PhonSk, and ELSA. Illustrations of the interactions are displayed in Figure 1. For the three dependent variables with statistically significant interactions, the slope of the treatment group was steeper than the slope of the control group, suggesting greater growth on these measures.

The means, standard deviations, and effect sizes for the PPVT III and WLPB are reported in Table 5. The treatment group's effect sizes were moderate for all measures, ranging from .46 to .66. The effect sizes of the control group ranged from extremely small (.02) to moderate (.41). The results of the ANOVAs are reported in Table 6. Two of the four interaction effects were statistically significant, PPVT III and Memory for Sentences. The interactions were plotted in Figure 2. Disordinal interactions were found for both the PPVT and Memory for Sentences with the treatment group having a lower pretest mean than the control group but obtaining a higher mean on the posttest for both significant interactions.

Discussion

Major Findings

Although the "science of reading" provides important guidance for the phonemic awareness and other early literacy skills that can build a bridge to reading, translating this instruction for students who are nonverbal or have limited language and who need intensive instruction to master new skills is a current challenge. The lack of focus on decoding (Browder, et al, 2006; Joseph & Seery, 2004) and the lack of attention to literacy in general for this population (Kliewer, 1998; Kliewer, Biklen, & Kasa-Hendrickson, 2006) have been well established in the literature. The first

outcome of this study was that an early literacy curriculum could be created that could be used by students with significant disabilities and was acceptable to a panel of experts in severe disabilities, early literacy, direct instruction, and augmentative communication. Significant gains on the *ELSA* indicated that students who received the curriculum learned significantly more of the objectives than students who did not. Although not a surprising finding, this outcome was important to demonstrating that students in the *ELSB* acquired new skills.

In addition, the students also made significant gains on the phonemic awareness section of the *NVLA*. This result suggested that the experimental curriculum promoted skills that are known to be bridges to early reading. It should be noted that this gain occurred despite the fact that nearly all students had mastered only one or two levels of the five level curriculum in the first year. In contrast, one student with autism completed all levels of the curriculum which then made him a candidate for kindergarten level reading instruction in the second year. All other students were targeted for ongoing instruction in the *ELSB* in their second year. This outcome suggests that the path to reading may be possible for students with significant disabilities, but may also require more years of instruction. Additional research from the planned five year study will be critical to determine if these early gains do eventually produce fluent readers. This pace of skill acquisition also suggests that literacy instruction for this population needs to begin early and continue at least through the middle school years. In contrast, because of the significant developmental delay characteristic of this population, beginning this intensive instruction may not be feasible until the early elementary years for some students.

There were no statistically significant differences between the groups on the Conventions of Reading. This researcher-developed assessment was most closely aligned to the story-based lesson intervention that both the experimental and control students received. This could be interpreted to support the comparability of instruction the two groups received through the shared stories. Because

this measure reflects students' developing listening comprehension, it may be important in future research to focus on this specific intervention itself. In the Browder et al., (2006) review of experimental studies on reading for this population, not one example of a literature-based reading intervention was found. In contrast, qualitative research by Skotko, Koppenhaver, and Erickson (2004) and Kliewer and Biklen (2001) found that social engagement with stories enhanced communication skills for this population. More research is needed to determine the effect of engaging students with significant developmental disabilities in the reading of stories on their communication and emergent literacy skills.

Groups also differed in their performance on the PPVT III and Memory for Sentences subtest of the WLPB. There was no statistically significant difference between the groups on the Letter-Word Identification Subtest of the WLPB. One aspect of the ELSB is the presentation of multiple pictorial examples of a given concept/object. For example, three different photos/clip art of children at play (playing soccer, children on a slide, children running through a sprinkler) are provided to illustrate the concept of play. Typical picture vocabulary instruction uses one picture to illustrate a communication need. Demonstration that concepts/objectives have multiple types of representation may have impacted the PPVT III score. In the Memory for Sentences subtest students are given a short phrase or sentence to repeat verbatim. Participants receiving the ELSB curriculum may have benefited from increased focus on or knowledge of sentence structure from the fill-in the blanks with the missing word Objectives 2 and 4.

Another important outcome of this study was the demonstration that this population could participate in standardized assessment modified for nonverbal responding. The use of standardized assessment for students with significant developmental disabilities is challenging due to the varied ways students need to demonstrate learning given their sensory and physical challenges. In this study we did not try to include students with hearing and vision impairments. In contrast, we did adapt

response repertoires for students with significant physical, as well as intellectual, disabilities. It was especially encouraging that consistent responding could be established through eye gazing for some students. Placing the response options on the four corners of a piece of plexiglass made it possible for students to turn their eyes and heads slightly to indicate a distinct response.

Limitations of the Research Design

Conducting randomized trials research with a low incidence population presents substantial challenges. The potential advantage if these challenges can be surmounted is to provide strong evidence of intervention effectiveness. An alternative would be to use a series of single subject studies. In contrast, most single subject studies have focused on one specific component of reading, like sight words or only initial consonant sounds, rather than the impact of a full curriculum. Although a group research design lends itself well to comparing two approaches to reading, the application of inferential statistics is difficult due to the small sample size. For example, differences may have existed among the subgroups in this study (e.g., students with autism vs. those with severe intellectual disabilities) but such differences could not be analyzed given the small sample. Multivariate statistics were also not comparable which introduced the possibility of Type 1 error. As noted earlier, the effect sizes may be the most credible statistic for making inferences about the impact of the intervention with this small sample.

A second limitation in the design was that the primary findings were based on instruments developed by the researchers. This threat to internal validity was addressed by providing some support for the reliability of the instruments and through the use of published instruments that also indicated significant differences between the treatment and control group. Additional research is needed on the standardization and validity of the *NVLA* in particular, given the need for instruments that can be used to show gains for this population.

Implications for Practice

Although the outcomes of the study are encouraging that students with significant developmental disabilities can gain early literacy skills through intensive instruction, much more research is needed to determine if these skills will lead to learning to read and applying those skills to meaningful life contexts. Because experimental research that focuses on the NRP (2000) components of reading is new for this population, practitioners are left with many unanswered questions for planning literacy instruction. Until there is additional research to define evidence-based practice, the most logical approach may be to utilize and adapt strategies that have been found effective with students who are nondisabled. For example, research on shared stories (Bus, van IJzendoorn, & Pellegrini, 1995; Senechal, Thomas, & Monker, 1995; Vacca, et al., 2006) would support utilizing literature-based instruction. Sharing stories may build leisure enjoyment of books and promote language skills. Intensive instruction in phonemic awareness, decoding skills and comprehension should also be carefully considered for elementary aged students with significant disabilities. Prior research has shown that students with moderate intellectual disabilities can gain phonics skills (Barudin and Hourcade, 1990; Bradform, Shippen, Alberto, Houchins and Flores, 2006; Hoogeveen, Smeets, and Lancioni, 1989; Hoogeveen, Smeets, and van der Houven, 1987; Lane & Crutchfield, 1998; Bracey, Maggs, & Morath, 1975; Singh, J. & Singh, 1985; Singh N. N. & Singh, 1988). Our research shows early promise that students with severe intellectual disabilities and autism also can acquire some phonemic awareness and phonics skills. What is known from other research is that these skills are strong predictors of learning to read (Ball & Blachman, 1991; Treiman & Baron, 1983). What can be concluded is that if this population is to have the opportunity to learn to read, they will need instruction that teaches them to decode and comprehend printed text.

Needs for Future Research

Moving beyond sight words is a new venture in reading research for students with significant developmental disabilities. There is so much to discover, substantial energy and resources need to be invested to begin exploring this opportunity for this population. What will be important is to build on the science of reading that is already available. Until research indicates otherwise, the best starting point will be in adapting interventions proven effective for students who are typically developing. This requires gaining deeper knowledge of this literature as well as knowing what has been effective in teaching reading to students with significant disabilities. Research is especially needed on comprehensive and longitudinal curricula that school systems can adapt and modify for this population. It will be difficult for teachers to piece together a reading program from studies that focus on only one component of reading. Research is also needed on measures that show gains relevant to reading, but that are not biased against students who are nonverbal or have sensory of physical impairments. Through such research more students with significant disabilities may gain the skills needed to become readers.

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Table 1. Objectives Taught in the Early Literacy Skills Builder

Objective	Rationale/NRP Component	Increasing Difficulty Across Lessons and Levels	Method Used to Teach the Objective
1. Read vocabulary sight words	Some words are irregular and must be learned on sight; students also benefit from early word mastery to participate in reading the stories. NRP Vocabulary	New words are introduced across lessons and levels	Flash card drill with constant time delay (one round at zero delay; one at 5 seconds)
2. Point to sight words to complete sentences.	Students use sight words from Objective 1 to fill-in the blank to promote comprehension/ meaning of the words NRP Vocabulary	Students are given more distractors in answer choices as the levels progress	System of least prompts: (a) wait for student to point without help; (b) model pointing and have student imitate; and (c) if needed, physically guide to point*. If needed, words may be enlarged.
3. Point to words as teacher reads them aloud.	Text pointing is used to promote the concept of word. It teaches that text moves from left to right and top to bottom and that each printed word can be spoken. For nonverbal students it may build towards the use of technology support to read aloud. Concept of Print	Students progress from pointing to a phrase to a sentence to moving down the page to a second line of text as the teacher reads. In the upper levels, students point to each word individually within the sentence.	System of least prompts (same as above).
4. Point to or say a word to fill in a repeated story line.	This skill also promotes concept of word and listening comprehension as student fills in missing word. NRP Comprehension	Placement of word in the sentence varies (last word, middle word). At the early levels, the missing word is highlighted. Words change across lessons and levels.	System of least prompts (same as above).
5. Respond to a question about the story by	This builds listening comprehension. As students practice text	At first, literal questions that relate directly to the text are	Scaffolding (find answer in sentence) and then system of least prompts

selecting correct picture (later lessons-correct word). May answer verbally.	pointing to help "read" the story (see #3), it also conveys the idea of reading comprehension. NRP Comprehension	asked. Later students are asked harder questions (main idea, sequencing) and to make inferences from what has been read. In later lessons answer questions using words versus pictures.	if needed.
6. Demonstrate understanding of segmentation by clapping out syllables in words 7. Demonstrate understanding of segmentation by tapping out phonemes in CVC words	Segmenting is one of the critical components of phonemic awareness. Segmenting words into syllables is the beginning point because it teaches distinguishing by auditory cues including rhythm and stress. Auditorially segmenting sounds in words is the primary precursor in learning to read CVC words. NRP Phonemic Awareness	Early lessons use one and two syllable words; words increase to 4 syllables and then CVC words.	Direct instruction model, lead, test strategy. If incorrect response, teacher physically guides the clapping. "Clapping" is adapted to student response ability (e.g., student with physical challenges may tap foot or hit side of wheelchair).
8. Identify letter-sound correspondence	Students who are nonverbal (and some with autism) will need a visual referent to indicate letter sounds. Use of letters themselves may be more efficient than some other concrete referent. NRP Phonics	New letters and sounds are introduced across lessons and levels. In the first section of this objective there is no distractor. Distractors begin with non-letter options. Later students are given multiple letters from which to choose.	Easy to hard discrimination with increasingly more difficult distractors. Given an incorrect response the system of least prompts is used.
9. Identify first and last sounds in words. 10. Find pictures that begin/end with specific sound.	Isolating beginning sounds is a critical phonemic awareness skill and a precursor to beginning reading. NRP Phonemic Awareness	Sounds change across letters and lessons. Consideration given to order of phonemes from easy to hard.	Direct instruction with model, lead, test strategy. Given an incorrect response the system of least prompts is used. First and last sounds are also highlighted.
11. Point to	Blending is one of the	Sounds to be blended	Direct instruction with

letters in words that have been segmented. 12. Point to pictures that represent segmented words	most difficult skills to translate for nonverbal students. Although voice output devices can produce the word, they do not require the student to think about the blending itself. If students can hear a segmented word, and identify a picture of the word that was said, this demonstrates having internally blended the sounds. While more difficult than simple verbal blending, it ensures students are not just "hitting a switch" to say a word. NRP Phonemic Awareness	changed over lessons and levels concurrent with those introduced in objective 8.	model, lead, test strategy. Given an incorrect response the system of least prompts is used.
13. Pointing to pictures of spoken words.	This skill builds conceptual understanding of vocabulary by using a variety of pictures for the same spoken word. Students are asked to identify the written word and multiple picture representations. They are also asked to match the written word to the pictures to demonstrate comprehension. NRP Vocabulary	First words are people. Less concrete words are introduced including feelings, places, and actions. Each level has a theme that is meaningful to children (friends, pets, community outings, birthday).	System of least prompts (same as above).

Note. NRP = National Reading Panel, CVC = consonant-vowel-consonant
*Students who respond using eye gazing (minimal or no use of hands and arms) can be guided to correct answer by showing the correct response with a stimulus prompt such as a light pointer or colored frame.

Table 2

Description of Treatment and Control Groups

Characteristic		Control		Treatment	
		N	*%*	*N*	*%*
Gender					
	Male	6	50.0	7	63.6
	Female	6	50.0	4	36.4
Ethnicity					
	African American	6	50.0	6	54.5
	Caucasian	4	33.3	4	36.4
	Other	2	16.7	1	9.1
Verbal Status					
	Verbal	5	41.7	6	54.5
	Non-Verbal	7	58.3	5	45.5
Class Type					
	SAC	6	50.0	6	54.5
	Autism	3	33.3	3	36.4
	Severe/Profound	2	16.7	2	9.1
Grade					
	K	4	33.3	0	0
	1	6	50.0	4	36.4
	2	1	8.3	5	45.5
	4	1	8.3	2	18.2
Free/Reduced Lunch					
	None	4	33.3	4	36.4
	Reduced	0	0	0	0
	Free	3	25.0	3	27.3
	Did Not Answer	5	41.7	4	36.4
		M	Range	M	Range
Age		8.75	8-10	9.36	9-11
IQ		37.55	18-54	36.50	20-50

Note. SAC = Specialized Academic Curriculum for students with moderate intellectual disability,

N = number of participants, M = mean

Table 3

Mean and Standard Deviation for Minutes Spent in Types of Literacy Instruction per Day

Group	ELSB		SBL		Sight Words/ Pictures		Other Literacy		Total Mean	
	M	sd	M	sd	M	sd	M	sd	M	sd
Treatment	18.49	10.23	9.27	6.08	10.51	4.34	17.96	7.33	56.23	16.38
Control	0		11.62	6.60	16.15	14.28	25.14	7.02	52.91	22.75

Note. ELSB = Early Literacy Skills Builder, SBL = story-based lessons, M = mean, sd = standard deviation

Table 4

Means, Standard Deviations, and Cohen's d for Pretest and Posttest on the NVLA and ELSA

		Pretest		Posttest		
		M	*SD*	*M*	*SD*	Cohen *d*
	NVLA Total					
Control		40.92	30.94	63.58	39.13	.65
Treatment		36.27	21.42	72.55	37.92	1.22
	CVR					
Control		9.92	5.53	17.00	5.86	1.24
Treatment		11.82	4.40	19.00	4.77	1.57
	Phon Sk					
Control		32.27	25.50	47.36	33.49	.51
Treatment		25.3	16.51	56.60	30.00	1.35
	ELSA					
Control		40.33	35.40	54.08	35.73	.39
Treatment		42.64	30.80	79.00	32.69	1.15
	PPVT III					
Control		18.83	15.76	18.42	18.31	.02
Treatment		14.36	12.18	20.82	15.76	.46
	WLPB Total					
Control		12.58	13.50	15.58	17.92	.19
Treatment		12.00	12.30	21.45	16.30	.66
	Memory for Sentences					
Control		9.83	11.67	9.83	12.80	<.01
Treatment		7.73	9.14	14.18	10.70	.65
	Letter Word Identification					
Control		1.83	2.98	3.42	4.80	.41
Treatment		3.18	4.35	5.55	5.54	.48

Note. NVLA = Nonverbal Literacy Assessment, CVR = conventions of reading section of the NVLA, Phon Sk = phonics and phonemic awareness section of the NVLA, ELSA = Early Literacy Skills Assessment of the Early Literacy Skills Builder curriculum, PPVT III = Peabody Picture Vocabulary Test III, WLPB = Woodcock Language Proficiency Battery.

Table 5

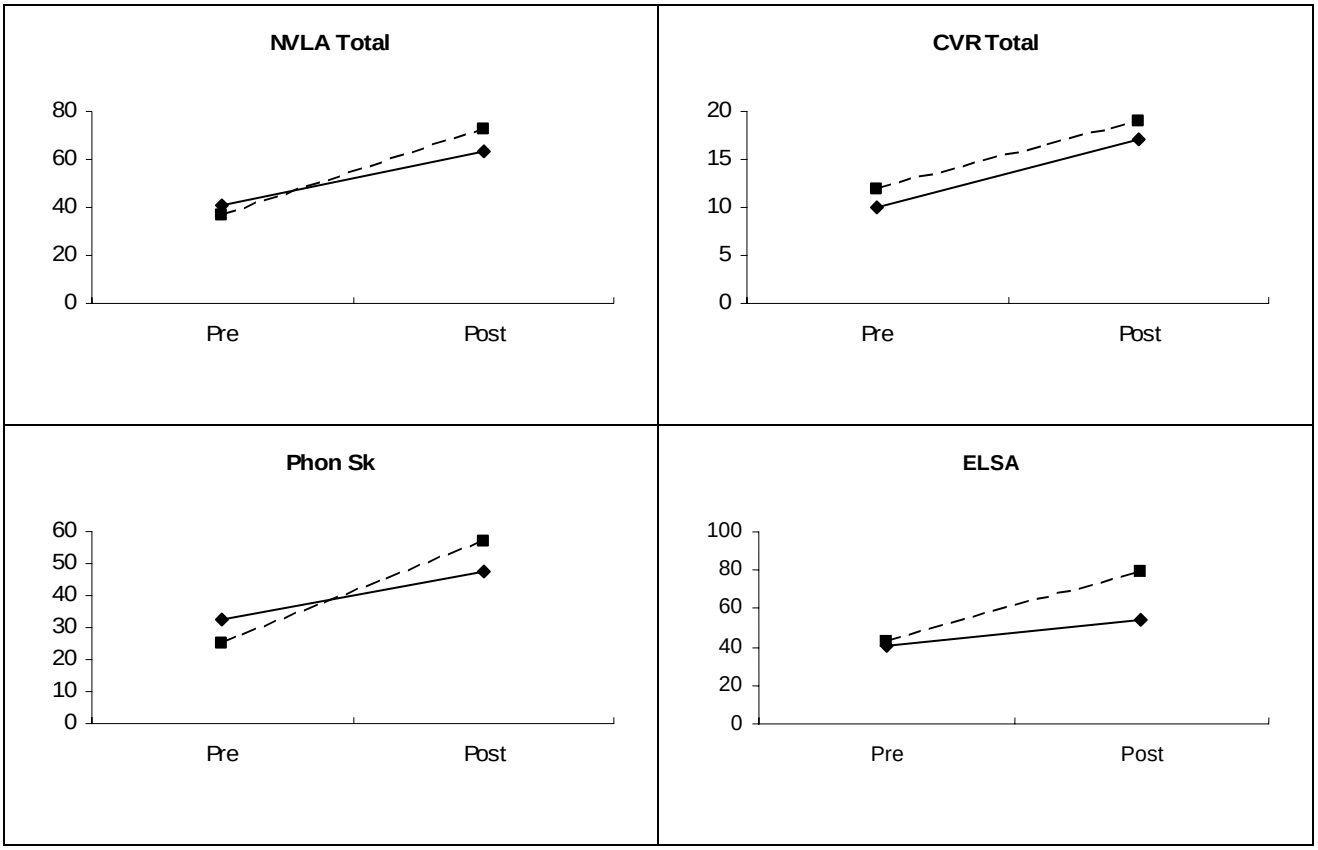
Results of Repeated Measures ANOVA for the NVLA and ELSA

Outcome		Effect	*F-Ratio*		η^2_p
NVLA					
	Within-Ss	Pre/Post	40.47	**	.66
		Interaction	3.47	*	.14
	Between-Ss	Instruction	.21		.01
CVR					
	Within-Ss	Pre/Post	24.82	**	.54
		Interaction	.01		<.01
	Between-Ss	Instruction	1.01		.05
PhonSk					
	Within-Ss	Pre/Post	32.83	**	.63
		Interaction	5.57	**	.23
	Between-Ss	Instruction	.22		.01
ELSA					
	Within-Ss	Pre/Post	17.42	**	.45
		Interaction	3.56	*	.15
	Between-Ss	Instruction	1.14		.05
PPVT					
	Within-Ss	Pre/Post	2.80		.12
		Interaction	3.63	*	.15
	Between-Ss	Instruction	.03		<.01
WLPB Total					
	Within-Ss	Pre/Post	8.23	**	.28
		Interaction	2.21		.10
	Between-Ss	Instruction	.20		.01
Memory for Sentences					
	Within-Ss	Pre/Post	4.59	*	.18
		Interaction	4.59	*	.18
	Between-Ss	Instruction	.06		<.01
Letter Word Identification					
	Within-Ss	Pre/Post	8.25	**	.28
		Interaction	.32		.02
	Between-Ss	Instruction	.99		.04

Note. ** $p<.01$, *$p<.05$. Degrees of freedom for all tests of significance was 1, 21.

Figure 1. Illustrations of the interaction effects for the measures of NVLA and ELSA.

Figure 2. Illustrations of the interaction effects for the measures of PPVT III and WLPB.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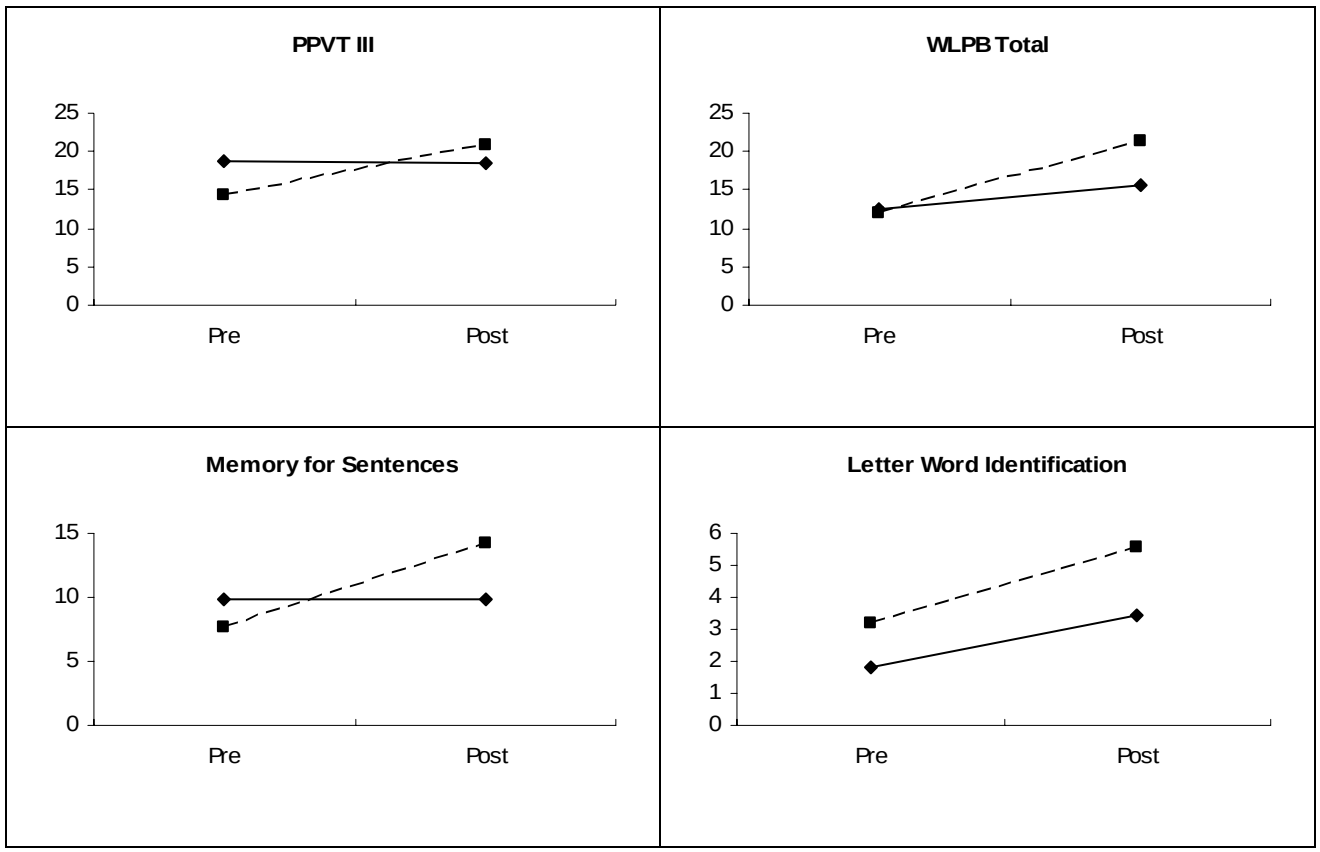
60
40
20
0
Pre
Post
CVR Total
20
15
10
5
0
Pre
Post
Phon Sk
60
50
40
30
20
10
0
Pre
Post
ELSA
100
80
60
40
20
0
Pre
Post


PPVT III
25
20
15
10
5
0
Pre
Post
WLPB Total
25
20
15
10
5
0
Pre
Post
Memory for Sentences
15
10
5
0
Pre
Post
Letter Word Identification
6
5
4
3
2
1
0
Pre
Post