Increasing Literacy Skills for Students with Intellectual and Developmental Disabilities: Effects of Integrating Comprehensive Reading Instruction with Sign Language

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Abstract: This study evaluated the impact of a comprehensive reading program enhanced with sign language on the literacy and language skills of three elementary school students with intellectual and developmental disabilities. Students received individual and small group comprehensive reading instruction for approximately 55 minutes per session. Reading instruction combined the PCI Reading Program with literacy and language activities to target concepts of print, phonemic and phonological awareness, sight word recognition, vocabulary and oral language, and comprehension. Results indicated that all three participants showed growth in their literacy skills, specifically in the areas of letter identification, letter-sound knowledge, sight word knowledge, receptive vocabulary, and listening comprehension. Implications for future research and educational practices for utilizing comprehensive reading instruction are discussed.

The improvement of reading outcomes for students with disabilities has received increased focus in recent years. Key legislation and federal initiatives guiding this focus include the Individuals with Disabilities Education Act of 1997 and its reauthorization in 2004 (IDEA, 2004) requiring that all students have access to general education curriculum; the 2001 reauthorization of the Elementary and Secondary Education Act (i.e.; No Child Left Behind Act [NCLB]; NCLB, 2001) emphasizing outcomes on state content standards including reading standards; and the National Reading Panel’s establishment and subsequent report assessing evidence-based literacy instruction and its implications for practice (NICHD, 2000). Given that less than 25% of children with mild to moderate intellectual disability (ID) acquire basic literacy skills (Katims, 2001), the focus of these initiatives is timely. As society places increased emphasis on use of literacy skills in daily life, the failure of students with ID to develop basic literacy not only limits acquisition of basic academic skills across grade levels, but it has implications that extend beyond the classroom to impact postsecondary employment and independent living (Browder et al., 2009).

Until recent years, research and practice primarily focused on sight word instruction as the primary means of literacy instruction for students with moderate ID (Bradford, Alberto, Houchins, Shippen, & Flores, 2006; Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006; Browder & Xin, 1998). Although research has demonstrated the effectiveness of sight word instruction on word identification, it has provided limited investigation into the assessment and application of word meaning. A more narrow body of research has indicated positive outcomes in teaching discrete reading subskills to students with ID and developmental disabilities (DD). This includes teaching phonemic tasks such as sound segmentation (Hoogeveen, Birkhoff, Smeets, Lancioni, & Boelen, 1989) and phonological tasks such as letter-sound correspondence (e.g., Flores, Shippen, & Alberto, 2004; Hoogeveen, Smeets, & van der Houven, 1987) and decoding (e.g., Cohen, Heller, Alberto, & Fredrick, 2008). Although instruction was proven effective, these studies targeted isolated skills without examining the
strategy use within the context of comprehensive reading instruction, as recommended by the National Reading Panel (i.e., instruction which addresses phonemic awareness, phonics, fluency, vocabulary, and comprehension) (NICHHD, 2000).

Most promising though in changing literacy outcomes for students with ID/DD is the recent research on comprehensive reading instruction (Allor, Mathes, Roberts, Cheatham, & Champlin, 2010; Allor, Mathes, Roberts, Jones, & Cheatham, 2010; Browder, Alhgrim-Delzell, Courtade, Gibbs, & Flowers, 2008). In a randomized control group study, Browder and colleagues (2008) examined the effect of an early literacy curriculum, Early Literacy Skills Builder (Browder, Gibbs, Ahlgrim-Delzell, Courtade, & Lee, 2007), on both literacy and language outcomes for verbal and non-verbal students with moderate to profound ID in grades K to 4. The curriculum, which was implemented for seven months, targeted concepts of print, phonemic awareness, sight word instruction, vocabulary, and listening comprehension. Although statistically significant effects were demonstrated on a measure of phonemic awareness, the slow progress rate indicated the need for multiple years of instruction to acquire competency in basic literacy skills. Allor, Mathes, Roberts, Cheatham, et al. (2010) conducted a longitudinal study to examine the effect of comprehensive reading instruction on students with mild and moderate ID. The curriculum, Early Interventions in Reading (Mathes & Torgeson, 2005a, 2005b), was supplemented with phonemic awareness and oral language instruction to ensure all components of reading instruction as well as student prerequisite skills were addressed. For two to three years students received 40–55 minutes of small group individualized instruction resulting in minimal progress during the first year of intervention with three years to achieve mastery of first grade reading skills. Although results were highly variable across participants, significant effects were demonstrated for the treatment group on measures of phonemic segmentation and phonological decoding. The results from these studies suggest that students with ID can acquire basic literacy skills when provided extended instruction using a comprehensive reading curriculum.

In conjunction with this research, components of reading instruction critical to effectiveness for students with ID/DD have been described (Allor, Mathes, Champlin, & Cheatham, 2009; Allor, Mathes, Roberts, Jones, et al., 2010; Browder et al., 2006). First, instruction must address the components of concepts of print, phonemic awareness, phonological awareness, word recognition, vocabulary and oral language, fluency, and comprehension. Second, instruction in each skill area must be explicit and should be coupled with explicit instruction to support integration and application of skills. For instance, vocabulary and oral language are foundational to other reading components and as such the meaning of language should continually be addressed across all reading instruction. Third, modifications must be made to the intervention based on participant needs to ensure access to the curriculum and mastery of new concepts. Instructional modifications may include repetition, least to most prompting, reinforcement, visuals, and careful pacing of lessons and new skills. Fourth, progress monitoring is critical for evaluating progress and adjusting instruction.

Even though the components for effective comprehensive reading programs for students with ID/DD have been established, gaps still exist in the literature. One identifiable gap relates to the role of supplemental visuals in supporting the development of basic literacy skills. Allor and colleagues (2009) describe varied use of visuals to support student literacy development, including pictures and gestures to demonstrate meaning of new vocabulary as well as gestures and mnemonic clues to teach letter-sound correspondence. Although visuals are effective for making abstract concepts concrete and for creating associations that enhance recall, the challenge of ensuring consistent use across instructors and settings exists. Sign language has been proven an effective strategy to support language acquisition for students with autism (Carbone, Sweeney-Kerwin, Attanasio, & Kasper, 2010) and sight word recognition for students with ID (Sensenig, Mazeika, & Topf, 1989), but sign language as a visual prompt has not been investigated in the context of a comprehensive reading intervention. Sign language offers increased consistency in im-
plementation across personnel and settings and increased ease in instructional design as prompts do not require development as do print visuals. The potential use of sign language within a comprehensive reading program warrants further investigation. Thus, this study targeted the following research question: What are the effects of a comprehensive reading program integrated with sign language on (a) sight word knowledge, (b) letter recognition, (c) letter-sound knowledge, (d) vocabulary, and (e) listening comprehension of students with ID/DD?

Method

Setting and Participants

The study took place in an Southeastern elementary school in a self-contained classroom serving students diagnosed with mild to moderate ID and DD. Criteria for participant selection included (a) students placed in the classroom who had not previously participated in the reading curriculum, (b) a diagnosis of moderate ID or DD, and (c) reading level at a prekindergarten to kindergarten level. Four students were initially identified who met the criteria, but only three students completed the study. The fourth student was withdrawn from the study during baseline due to behaviors which interfered with instructional engagement. The student demonstrated limited focus to task and non-compliant avoidance behaviors (e.g., hiding under the table) when instructional tasks were presented.

Kyle was a 7 year 11 month old Caucasian male in the second grade. This participant was served under significant DD eligibility, but had a medical diagnosis of autism. Kyle also received one hour of speech services per week due to language deficits. Kyle read on a below kindergarten level as assessed by a literacy inventory developed by the particular district in which the study took place. Kyle’s receptive vocabulary, as measured by the Peabody Picture Vocabulary Test-III (PPVT-III; Dunn & Dunn, 1997) was an age equivalent of less than 1 year. Kyle’s expressive vocabulary and listening comprehension, as measured by the Test of Language Development Primary: 3 (TOLD P: 3; Newcomer & Hammill, 1997), was in the one percentile range. Kyle exhibited several behaviors impeding daily instruction in his classroom: attention issues, limited communication, a low frustration level, and physical aggression towards others.

Jacob was a 10 year old Caucasian male in the fourth grade. He was served under moderate ID eligibility, but also had a medical diagnosis of autism and attention deficit hyperactivity disorder (ADHD)-inattentive type. Jacob received one hour of speech services per week due to language deficits. Jacob was reading below a kindergarten level as measured by the district developed reading assessment. The PPVT-III, which measures receptive vocabulary, revealed Jacob had an age equivalent score of 5 years. Jacob’s expressive vocabulary and listening comprehension, as measured by the Test of Language Development Intermediate: 3 (TOLD I: 3; Hammill & Newcomer, 1997), were below the 1st percentile. Jacob exhibited several behaviors impeding daily instruction in his classroom. These included attention issues, limited communication, a low frustration level, limited eye contact with others, and a highly emotional state.

Brianna was a 9 year 8 month old African American female in the fourth grade. This participant received services for moderate ID and speech-language impairment, including an hour of speech services a week. She also had a medical diagnosis of ADHD-combined type. Pretests with the system literacy assessment indicated Brianna was reading at a kindergarten level. The PPVT-III revealed Brianna had a receptive language level of 5 years. Brianna’s expressive vocabulary listening comprehension, as measured by the TOLD I: 3, was at the 3rd percentile. Brianna exhibited several behaviors impeding daily instruction in her classroom including attention issues, verbal and physical aggression towards others in her classroom, refusal to complete tasks or communicate with others during instruction, and a need for constant rewarding. Her daily classroom performance was inconsistent varying from completing work effortlessly without teacher assistance to refusal to begin a given task. Detailed information on all participants is provided in Table 1.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Age/Gender</th>
<th>Diagnoses</th>
<th>Communication Skills</th>
<th>Behaviors Impeding Daily Instruction</th>
<th>Literacy Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyle</td>
<td>7/Male</td>
<td>Significantly Developmentally Delayed, Autism</td>
<td>• Inconsistent communication&lt;br&gt;• Difficulties forming sentences and thoughts&lt;br&gt;• Speaks in two to three word utterances</td>
<td>• Attention issues&lt;br&gt;• Limited communication&lt;br&gt;• Low frustration level&lt;br&gt;• Physically aggressive</td>
<td>• Understands name&lt;br&gt;• Can recognize name in print&lt;br&gt;• No knowledge of written words or sentences&lt;br&gt;• Unable to attend to text without prompting</td>
</tr>
<tr>
<td>Jacob</td>
<td>10/Male</td>
<td>Moderate Intellectual Disability, Autism, ADHD- Inattentive Type</td>
<td>• Inconsistent communication&lt;br&gt;• Difficulties forming full sentences and thoughts&lt;br&gt;• Speaks in two to five word utterances</td>
<td>• Attention issues&lt;br&gt;• Limited communication&lt;br&gt;• Low frustration level&lt;br&gt;• Limited eye contact with others&lt;br&gt;• Very emotional (cries often)</td>
<td>• Understands name&lt;br&gt;• Can recognize name in print&lt;br&gt;• No knowledge of words or sentences&lt;br&gt;• Unable to attend to text without prompting</td>
</tr>
<tr>
<td>Brianna</td>
<td>9/Female</td>
<td>Moderate Intellectual Disability, ADHD- Hyperactive and Impulsive Type</td>
<td>• Inconsistent communication&lt;br&gt;• Difficulties expressing thoughts in complete sentences</td>
<td>• Attention issues&lt;br&gt;• Verbally and physically aggressive&lt;br&gt;• Will shut down and refuse to participate when frustrated&lt;br&gt;• Needs constant rewards</td>
<td>• Understands name&lt;br&gt;• Can recognize name in print&lt;br&gt;• Can read books at a kindergarten level</td>
</tr>
</tbody>
</table>
Interventionist

Students were served in the classroom by a special education teacher, who was the researcher and first author in this study, and two paraprofessionals. All reading instruction in this study was provided by the researcher. The researcher was certified in special education and was in the process of obtaining a specialist’s degree in special education. She had five years teaching experience, four of which were in her current position. Training specific to the intervention included a one-day PCI reading curriculum training and an introduction to sign language course, focused on basic sight word signs.

Baseline Procedure

Participants received literacy instruction as outlined by The PCI Reading Program: Level One (PCI, 2007a), a district-mandated curriculum focused on sight word reading. As outlined by the curriculum, each lesson involved 15 to 25 minutes of activities and the instructional rotation repeated every 6 days. On days 1 through 5, a new sight word was introduced each day. Each sight word lesson was broken into four parts: a learn-the-word activity, a trace-the-word activity, hands-on practice, and independent practice. For the learn-the-word activity, students read each new and previously learned sight word in isolation and together in simple phrases and sentences. In the trace-the-word activity, the new word was presented as part of a picture phrase and the student traced the word and read the phrase. The hands-on practice included student manipulation of word and picture cards to form simple phrases and sentences. Independent practice included two worksheets prompting students to apply their knowledge of newly learned sight words. On day 6, a book incorporating previously learned sight words along with comprehension questions was covered. All instruction was provided one-to-one to each participant at a kidney shaped table in the self-contained classroom.

Intervention Procedure

Overview and instructional features. To provide participants with comprehensive reading instruction, the PCI program was paired with activities targeting concepts of print, phonemic awareness, phonological awareness, listening and reading comprehension, and vocabulary. Sign language was integrated as an additional component across all aspects of reading instruction. Participants received 55 minutes of literacy instruction during each reading session in a small group setting. The reading sessions included 15 minutes of one-on-one instruction with the PCI Reading Program Level One and Level Two (PCI, 2007a, 2007b) reading series which was enhanced by sight words being paired with pictures and signs for individual words. (Note: Brianna was the only participant, due to her mastery of sight words in PCI Level One, to be introduced to the PCI Level Two series.) As each student received the one-to-one instruction, other students rotated through teacher-designed center-based literacy activities for 30 minutes. The center format was utilized to provide students with individualized instruction and concept reinforcement in phonemic and phonological awareness and vocabulary. Individual letter signs were utilized in these activities when instructing letter identification and letter-sound association. Finally, all participants engaged in a small group read aloud for 10 minutes. The read aloud involved student and/or teacher-led reading of kindergarten level Accelerated Reader (AR) books (Renaissance Learning, n.d.). Concepts of print and decoding practices were embedded during the reading. Comprehension questions were asked before, during, and after the text to promote increased comprehension skills. Sign was utilized to prompt reading of sight words and decoding of words.

Evidence-based practices for enhancing reading instruction for students with ID/DD (Allor, Champlin, Gifford, & Mathes, 2010; Allor et al., 2009; Allor, Mathes, Roberts, Jones, et al., 2010; Browder et al., 2006) were embedded across the intervention and were individualized according to student needs. Practices included screening assessments and progress monitoring to inform instruction, systematic and explicit instruction, repetition, systematic prompting, visual cues, and supported practice. Additionally, in order to increase positive behaviors including student
motivation and to reduce frustration, opportunities for success, continuous positive reinforcement, and time delay techniques were applied in each lesson.

**Literacy strands and activities.** The combined intervention of PCI with integrated sign language and the teacher-designed literacy activities were utilized to target key literacy strands: concepts of print, phonemic and phonological awareness, sight word recognition, vocabulary and oral language, and comprehension. Following is a brief description of skills targeted and activities implemented within each strand.

**Concepts of print.** Skills addressed included tracking from left to right and line to line, identifying book titles, identifying the first and last parts of the story, connecting pictures to text, and identifying words on a page by pointing and reading verbally. Skills were targeted through teacher modeling and student demonstration of skills during PCI reading instruction, particularly PCI sight word books, and AR read alouds.

**Phonemic and phonological awareness.** Phonemic and phonological skills targeted included phoneme detection and manipulation, letter recognition, letter-sound knowledge, initial sound recognition, and phoneme blending. Activities included stretching and connecting word exercises, matching upper and lower case letters, identifying initial letters and sounds in words and pictures, using sight words for spelling, and decoding practice. Visual cues (i.e., pictures and sign language) were critical for making letter recognition, letter-sound knowledge, and initial sound recognition more concrete. For instance, letter-sounds were first introduced by pairing the sound with a concrete object such as \( a \) for apple and with the letter sign. Sight words from the PCI curriculum were utilized to develop individualized student lists to design spelling and phoneme blending activities. Instruction in phonemic and phonological awareness was provided through center-based activities and the AR read alouds.

**Sight word recognition.** Instruction guided visual discrimination and verbal identification of sight words. Activities to develop sight word recognition included discriminating the word from other words, tracing the word, identifying the word in text, reading PCI sight word books, and identifying the word in alternative contexts (i.e., generalization practice of words in settings outside the classroom). The PCI curriculum was the primary means of sight word instruction. However, sight words were reinforced through center-based learning activities and AR read alouds. Sight words were also used in the instruction of other skills (e.g., initial sound identification, phoneme blending). Visual cues were integral to sight word instruction as each sight word was introduced by pairing the word with a sign and when appropriate, picture.

**Vocabulary and oral language.** Vocabulary and oral language instruction targeted increasing verbal identification of objects and words in the environment and in texts. Activities included matching pictures to words, matching simple phrases and sentences to pictures, constructing sentences from word and picture cards, labeling of objects in the environment, identifying pictures in texts, questioning to check vocabulary understanding during reading, and discussing text before, during, and after reading. New vocabulary words were presented to students in various ways using concrete objects, pictures, and sign language. Vocabulary instruction was embedded across all reading activities and students were offered opportunities to practice new vocabulary during PCI lessons, center-based activities, and read alouds.

**Comprehension.** Comprehension instruction focused on increasing a student’s ability to understand a given text, specifically simple fact recall and event sequencing. Comprehension skills were developed using PCI sight word text readings and AR read alouds. Specific skills taught to support comprehension included using pictures to gain meaning from text, activating prior knowledge, and checking understanding. Teacher questioning before, during, and after reading supported student comprehension and was used in conjunction with additional comprehension checks including PCI questions used with sight words book readings and AR tests used after AR read alouds.
Research Design

An A-B time series design in conjunction with pretest-posttest measures was utilized to examine the effects of the comprehensive reading program on each student. During baseline, participant reading instruction was a published sight word curriculum (i.e., PCI Education, 2007a). During intervention, participants received a comprehensive reading program integrated with sign language. The comprehensive reading program included the PCI curricula in addition to teacher designed reading materials which addressed evidence-based components for reading instruction. Prior to baseline and upon completion of intervention, formal assessment measures were utilized to assess each participant’s overall literacy skills. During baseline and intervention, participant progress was monitored with curriculum-based measures every five sessions. Progress monitoring data was utilized to inform pace and content of instruction.

Measures

Pre and posttest. The Woodcock Reading Mastery Test-Revised (WRMT-R; Woodcock, 1998), the PPVT-III, the TOLD P; 3 and I: 3, the Rigby PM Benchmark K-5 (Nelley & Smith, 2000), and the PCI Reading Program served as pre and posttest measures. The WRMT-R (i.e., subtest: Supplementary Letter Checklist) assessed letter identification and letter-sound knowledge, and the PPVT-III assessed receptive vocabulary. Due to student age, the TOLD P; 3 (i.e., subtests: Picture Vocabulary, Oral Vocabulary, Grammatical Understanding, Sentence Imitation, and Grammatical Completion) was utilized with Kyle and the TOLD I: 3 was utilized with Jacob and Brianna subtests (i.e., Malapropisms, Picture Vocabulary, Generals, Sentence Combining, Word Ordering, and Grammatical Comprehension) were utilized to assess listening comprehension and expressive vocabulary. The Rigby reading benchmark assessments were used to determine reading level and the PCI sight word lists were used to evaluate sight word knowledge. Pretests were given prior to baseline in early August and the posttests were given during the last week of November after intervention was complete.

Probes. Probes were used throughout the baseline and intervention phases of the study to continuously monitor participants’ progress. Probes were given once every five reading sessions by the interventionist. The probes measured sight word knowledge, letter recognition, and letter-sound knowledge. The sight word knowledge probe consisted of a checklist of 40 to 250 sight words with the number of words on each probe being determined by the PCI sight words each participant mastered. The letter recognition probe consisted of a checklist of 26 uppercase alphabet letters. For the letter-sound probe, participants were asked to identify short vowels and consonant sounds. For consonants that have both hard and soft sounds, participants were only asked to identify the hard consonant sound.

During baseline probes, participants were given an index card of each sight word (or letter) and asked to state the word (or letter). If a response was not given within 3 seconds, an incorrect response was marked on the data sheet. During intervention probes, participants were given an index card of each sight word (or letter) and asked to state the words (or letter). If a response was not given within 3 seconds, the participant was prompted by sign. If a response was not given within 3 seconds of the prompt, an incorrect response was marked on the data sheet.

Interobserver Agreement and Fidelity of Treatment

The classroom paraprofessional was trained by the interventionist in procedures for probe data collection and intervention implementation. Interobserver agreement training for probes was conducted over a period of 2 days before beginning the baseline. The training included discussions about the probes (i.e., what was being measured, how to assess student responses) and additional information such as where to sit during the observation, how to interact with participants, and what to do with collected data. Training data collected before beginning baseline across three mock reading sessions resulted in an agreement of 100%. During the study, interobserver agreement was measured during five probes for each participant or approximately 55% of the probes. The interobserver agreement was cal-
calculated by dividing the total number or agreements by the total number of agreements plus disagreements and then the total was multiplied by 100%. The interobserver agreement (IOA) revealed 100% agreement for each probe. To evaluate intervention fidelity, implementation was assessed by an observer approximately 33% of the sessions. A 3-point rating scale for reading intervention fidelity modeled on the scale developed by Allor, Mathis, Roberts, Jones, et al. (2010) was utilized. The agreement revealed a mean rating of 3 across all observations for 100% implementation fidelity.

Results

Results indicate participants demonstrated gains in letter identification, letter-sound identification, sight word knowledge, listening comprehension, and receptive vocabulary.

Participant pretest and posttest score comparisons for all reading measures are provided in Table 2. Letter-sound knowledge and letter identification probes are presented in Figure 1 and sight word knowledge probes are presented in Figure 2.

Kyle

The letters Kyle identified increased from pretest to posttest by 15 uppercase and 14 lowercase letters. The letter identification probes indicated a mean of 10.3 (range = 10–11) letters identified during baseline and a mean of 21 (range = 16–25) during intervention. Letter-sounds identified increased by 17 from pretest to posttest. The mean for letter-sound knowledge probes for baseline was .3 (range = 0–1) and for intervention was 12.3 (range = 5–20). Sight word knowledge increased 25 words from pretest to posttest. The

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**TABLE 2**

Participants’ Pre and Posttest Scores

<table>
<thead>
<tr>
<th></th>
<th>Kyle</th>
<th>Jacob</th>
<th>Brianna</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Letter Knowledge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>10 upper and 11 lowercase</td>
<td>10 upper and 7 lowercase</td>
<td>8 upper and 9 lowercase lowercase</td>
</tr>
<tr>
<td>Posttest</td>
<td>25 upper and 25 lowercase</td>
<td>24 upper and 24 lowercase</td>
<td>26 upper and 26 lowercase</td>
</tr>
<tr>
<td><strong>Letter-Sound Knowledge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>3 sounds</td>
<td>0 sounds</td>
<td>8 sounds</td>
</tr>
<tr>
<td>Posttest</td>
<td>20 sounds</td>
<td>22 sounds</td>
<td>26 sounds</td>
</tr>
<tr>
<td><strong>Sight Word Knowledge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>3 out of 40 words</td>
<td>1 out of 40 words</td>
<td>83 out of 250 words</td>
</tr>
<tr>
<td>Posttest</td>
<td>26 out of 40 words</td>
<td>36 out of 40 words</td>
<td>239 out of 250 words</td>
</tr>
<tr>
<td><strong>Receptive Vocabulary</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>&lt; 1.09 years</td>
<td>5.01 years</td>
<td>5.06 years</td>
</tr>
<tr>
<td>Posttest</td>
<td>2.11 years</td>
<td>5.10 years</td>
<td>5.09 years</td>
</tr>
<tr>
<td><strong>Listening Comprehension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>&lt; 1 percentile</td>
<td>&lt; 1 percentile</td>
<td>13 percentile</td>
</tr>
<tr>
<td>Posttest</td>
<td>35 percentile</td>
<td>10 percentile</td>
<td>27 percentile</td>
</tr>
<tr>
<td><strong>Expressive Vocabulary</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>1 percentile</td>
<td>&lt; 1 percentile</td>
<td>&lt; 1 percentile</td>
</tr>
<tr>
<td>Posttest</td>
<td>1 percentile</td>
<td>&lt; 1 percentile</td>
<td>&lt; 1 percentile</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>Below Kindergarten</td>
<td>Below Kindergarten</td>
<td>Kindergarten</td>
</tr>
<tr>
<td>Posttest</td>
<td>Below Kindergarten</td>
<td>Below Kindergarten</td>
<td>Kindergarten</td>
</tr>
</tbody>
</table>

Note: a Woodcock Reading Mastery Test-Revised. b PCI Reading Program. c Peabody Picture Vocabulary Test-III. d Test of Language Development P:3, I:3. e Rigby PM Benchmark K-5.
Figure 1. Probes for Letter-Sound and Letter Knowledge.
Figure 2. Probes for Sight Word Knowledge.
mean for sight word probes for baseline was 3 (range = 3) words and for intervention was 18 (range = 11–26). All probe data collected during intervention was non-overlapping with data collected during baseline. With the introduction of intervention, an immediate change in level and an accelerating trend occurred for all probe measures. Receptive vocabulary pre-post measures indicated age equivalency gains of 1.02 years. Listening comprehension pre-post measures indicated a gain from less than the 1st percentile at pretest to the 35th percentile at posttest. Measureable changes in expressive vocabulary and reading level were not observed.

**Jacob**

The letters Jacob identified increased from pretest to posttest by 14 uppercase letters and 17 lowercase letters. The letter identification probes indicated a mean of 9.3 (range = 8–11) letters identified during baseline and 20.5 (range = 15–24) during intervention. Letter-sounds identified increased by 22 from pretest to posttest. The mean for letter-sound knowledge probes for baseline was 3.3 (range = 2–4) and for intervention was 15.2 (range = 7–22). Sight word knowledge increased 35 words from pretest to posttest. The mean for sight word probes for baseline was 1.3 (range = 1–2) words and for intervention 21.8 (range = 11–36). All probe data collected during intervention was non-overlapping with data collected during baseline. With the introduction of intervention, an immediate change in level and an accelerating trend occurred for letter-sound knowledge and sight words. Receptive vocabulary pre-post measures indicated minimal gains in age equivalency (.09). Listening comprehension pre-post measures indicated a gain from less than the 1st percentile at pretest to the 10th percentile at posttest. Measureable changes in expressive vocabulary and reading level were not observed.

**Brianna**

The letters Brianna identified increased from pretest to posttest by 18 uppercase letters and 17 lowercase letters. These gains did not occur across intervention, but instead were immediately evident during baseline probes (mean = 26; range 26) and were maintained across intervention. Letter-sounds identified increased by 18 from pretest to posttest. The gains in letter-sounds were also evident during baseline probes (mean 24.3; range = 23–25) and were maintained during intervention (mean = 26; range = 26).

Sight word knowledge increased 156 words from pretest to posttest. The mean for sight word probes for baseline was 112.6 (range = 100–134) words. As with letter identification and letter-sound knowledge, gains were immediately evident in baseline probes. By baseline probe three, Brianna plateaued with the knowledge of 132 of the 140 sight words in PCI Level One. A decision was made to advance Brianna to the PCI Level Two program expanding the sight word base from 140 to 280 words. The rapid accelerating trend demonstrated between probe five and probe six is due to the addition of the PCI Level Two program which provided Brianna opportunity to demonstrate knowledge of 140 additional sight words. After intervention, her mean sight word recognition was 197 words (range = 132–239). Brianna’s receptive vocabulary pre-post measures indicated minimal gains in age equivalency (i.e., .03 year). Listening comprehension pre-post measures indicated a gain from the 13th percentile to the 27th percentile. Measureable changes in expressive vocabulary and reading level were not observed.

**Discussion**

The findings of this study provide further evidence that students with ID/DD can master basic literacy skills through comprehensive reading instruction. In this study, use of a comprehensive reading program enhanced with sign language resulted in gains in letter identification, letter-sound knowledge, sight word knowledge, receptive vocabulary, and listening comprehension. Even though probe data for these participants demonstrated consistent growth in reading subskills, overall reading levels remained unchanged for all participants. These findings are consistent with prior research wherein reading progress for students with ID/DD has been shown to occur at a slow rate. Further, effects of intervention on reading fluency and comprehen-
sion are typically measureable after decoding skills are established (Allor, Mathes, Roberts, Cheatham, et al., 2010) and all participants were at a beginning level of development in phoneme manipulation and letter-sound association skills.

The effectiveness of the intervention for increasing listening comprehension is an important contribution to the current literature. Listening comprehension gains for all students were extensive with percentile gains of 35 for Kyle, 10 for Jacob, and 14 for Brianna. Listening comprehension is the understanding of oral language, including single-word meaning, sentence meaning, and the ability to connect these parts with prior knowledge and context to create integrated meaning (Hogan, Bridges, Justice, & Cain, 2011). Gains in this study were attributed to the emphasis placed on the meaning of language by explicitly connecting spoken language, its meaning, and the written word. Instruction created language meaning by using pictures, concrete objects, and signs to teach vocabulary and sight words, and by using prompts to activate prior knowledge and questions to check understanding during individual reading and read alouds. Research examining the connection between language comprehension and reading comprehension suggests that reading comprehension is composed of two components, word recognition (i.e., decoding and sight words) and language comprehension (Catts, Adlof, & Weismer, 2006). Research further documents language comprehension deficits impact reading comprehension, even more than decoding deficits, for beginning and adolescent readers with and without disabilities. Based on the influence language comprehension has on reading comprehension, the language comprehension gains made by these students will serve as a basis for continued reading growth.

Sign language was integrated into the curriculum to provide students with an additional method of information retrieval. By combining word and letter signs with reading instruction, students received an alternative visual representation of new vocabulary and letters which served to support memory and recall (Daniels, 1996). Each student utilized the signs differently. Jacob, who exhibited more challenges transferring information from short term to long term memory, was most reliant on signs. For the majority of sight words and letters, Jacob would sign the word or letter to himself to prompt his recall before verbalizing the word or letter. For more abstract words or easily confused letters (e.g., m and w), Jacob relied on the teacher’s sign to prompt his recall. However, he did demonstrate a slowly growing repertoire of words and letters that he recalled without self or teacher prompted sign. Kyle utilized the signs, but internalized them more readily. With letter signs, he initially used them to self-prompt recall (i.e., signing the letter before speaking it), but he self-faded sign use as he mastered letter identification. With sight words, Kyle would use signs to prompt recall of words that were more abstract (e.g., as, town), but he did not use signs with words that were more concrete or those that he mastered more readily. Brianna responded differently to the signs. She did not utilize the signs herself nor did she rely on teacher sign prompts. Thus, each child individually adapted sign usage to support memory and retrieval. Interestingly, the students who benefited from the sign were dually diagnosed with autism and ID/DD. Given that sign language is an evidence-based practice for supporting language development in students with autism, the use of sign in reading instruction is a logical application. However, the effect is not limited to students with autism. Additional data collected on the intervention with students with ID/DD who are not dually diagnosed with autism indicates similar use and effects to that achieved with Jacob and Kyle (Beecher, 2011).

The use of a published sight word curriculum as the foundation for the intervention in this study has value to both research knowledge and practice applications. Although the use of a published sight word curriculum as the basis for a comprehensive reading curriculum is novel, the principles applied in development of the intervention and the components of the resulting curriculum were consistent with other comprehensive reading curricula researched for students with ID/DD (Allor et al., 2009; Allor, Mathes, Roberts, Cheatham, et al., 2010; Browder et al., 2008). The sight word instruction served as an inte-
eral component for teaching non-standard words and for providing access to print materials as decoding skills were being developed. For all students in this study, dramatic increases in sight word recognition occurred providing increased interaction with print materials. Additionally, the study illustrates how a teacher was able to supplement a district-mandated curriculum to provide comprehensive reading instruction. Similarly, Allor, Mathes, Roberts, Cheatham, et al. (2010) enhanced a reading curriculum to ensure adequate support for phonemic awareness and oral language development. These efforts demonstrate that it is feasible for teachers and curriculum specialists to modify and supplement curricular materials to ensure reading instruction for learners with ID/DD is comprehensive in its coverage of reading components and integrates evidence-based strategies.

Limitations and Future Research

Several limitations should be considered when interpreting the results from this study. First, consideration should be taken when interpreting Brianna’s data due to the variability between pretest and initial baseline probes and due to sight word gains outpacing the rate of words instructed. Variances were not related to testing, instructional conditions, or instruction, but appeared to be related to behavioral issues which prompted the question of the validity of her assessment data and pretest data as well as the psychological evaluation supporting eligibility for moderate ID. Second, this case-based evaluation of the intervention provides valuable preliminary data, but additional research utilizing stronger research controls with increased participants is necessary for further evaluation of the intervention. Assessment of long-term implementation would be valuable for examining the impact of the intervention on development of the additional skills of decoding, fluency, and comprehension. Third, the teacher serving as researcher created potential for bias, but this limitation was balanced by the benefits of successful teacher design, implementation, and assessment of a comprehensive reading program. Fourth, the multi-component intervention did not allow evaluation of the impact of the individual intervention components on reading skills. Further investigation into the use of sign language within comprehensive reading instruction and its benefits with students with ID/DD with varying learning characteristics and disabilities is warranted. The listening comprehension outcomes in this study also indicate closer examination to determine which components are most instrumental in facilitating the gain and to determine the growth pattern that occurs with long term implementation. Future research should also compare a comprehensive reading intervention with and without sign to evaluate the effect the specific component of sign language has on literacy skills mastered and rate of progress.

Recommendations for Practice

Reading programs for students with ID/DD should be comprehensive, addressing sight words as well as other key areas of reading instruction. Particular emphasis should be placed on developing understanding of language by use of visuals and connections to prior knowledge. Instruction should be systematic and explicit, provide repetition, and be highly motivating (Allor, Champlin, et al., 2010; Allor et al., 2009). Instruction should also be adapted to meet individual needs for pacing, access, prompting, and review and practice. Teachers should monitor student progress throughout their participation in the reading program and utilize data to adjust instruction. In designing or implementing a comprehensive reading program, teachers should seek out support from system reading specialists and secure professional development to facilitate understanding and implementation of evidence-based reading instruction. Finally, teachers should remember that the rate of reading progress varies by child and for some students success may only occur after a year or more of intervention (Allor, Mathes, Roberts, Cheatham, et al., 2010). Persistence and patience on the teacher’s part is critical so that students with ID/DD are provided the time to master literacy skills within a comprehensive reading program.

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