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Early Literacy Research for Students with Severe Developmental Disabilities:

University of North Carolina Project RAISE

Diane Browder, Principal Investigator

Lynn Ahlgrim-Delzell & Claudia Flowers, Co-Investigators

Fred Spooner, Faculty Associate

Angel Lee and Christy Hicks, Research Associates¹

From 2006-2010, a team at the University of North Carolina at Charlotte conducted a line of research on early literacy for students with severe developmental disabilities through Project RAISE Grant No. H324K040004 of the U.S. Department of Education, Institute of Education Sciences in partnership with the Charlotte Mecklenburg School System and Life Span Services. This project focused on students with moderate and severe developmental disabilities including intellectual disability and autism. Some participants also had physical or sensory disabilities. This project included reviews of research, curriculum development, research on assessment, research on intervention, and scale up.

Reviews of Research and Conceptual Model

Reviews of Research

In planning for literacy for students with severe disabilities, the research team built this literacy work on a comprehensive review of literature as a way to determine what evidence-based practices in reading instruction existed for students with moderate and severe developmental disabilities (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006).

¹ Lynn Ahlgrim-Delzell, Josh Baker, Ginevra Courtade, Susan Gibbs, and Candice Meyer were additional Research Associates for RAISE, during the six year history, who transitioned into faculty positions prior to the final year. Christy Hicks coordinated this final report. All inquiries should be directed to Diane Browder: dbrowder@unc.edu.

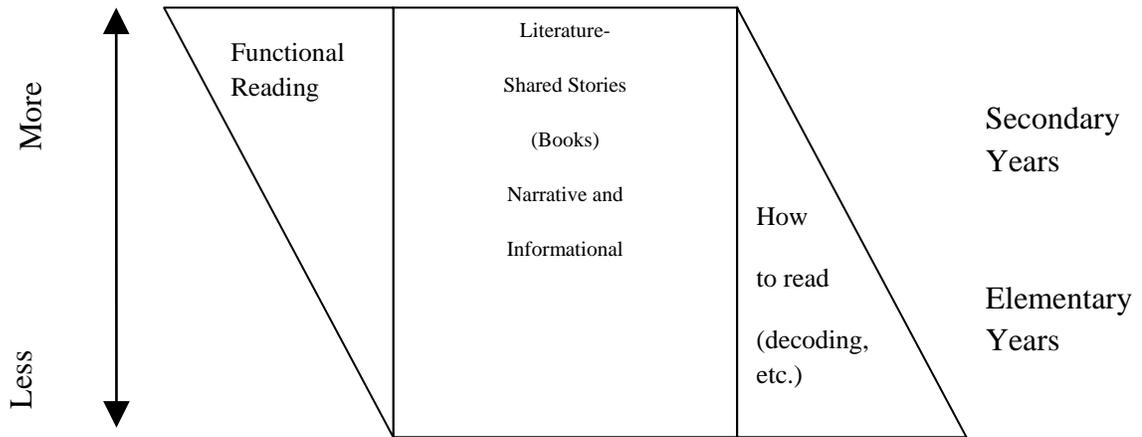
This literature was evaluated using the Horner et al. (2005) quality indicator criteria for single-subject research and the Gersten et al. (2005) criteria for group research. The initial collection of literature was gathered using electronic databases and print resources and the reference lists of five related literature reviews (Browder & Xin, 1998; Connors, 1992; Houston & Torgesen, 2004; Joseph & Seery, 2004; Morse & Schuster, 2004). Of the 128 studies included in the review of literature, 88 used a single-subject design and 40 used a group design. Most studies focused on teaching functional sight words and picture identification, which were taught in some cases with comprehension. Measures of comprehension in these studies were conspicuously absent with fewer than 31 studies containing any measure at all. Phonics instruction, phonemic awareness and fluency instruction comprised the remaining studies. This review revealed the importance of using systematic prompting and feedback such as time delay in literacy instruction.

Because the first review indicated that time delay might be an evidence-based practice, a comprehensive review was conducted on its application to literacy (Browder, Ahlgrim-Dezell, Spooner, Baker, & Mims, 2009). To be considered time delay, the independent variable had to contain the following components: (a) one or more trials at no delay of the prompt (zero second); (b) the student had the opportunity to identify each word or picture after the teacher prompt (e.g., repeating the word during the zero delay trials); (c) one or more trials at some delay of the prompt (e.g., four seconds); and (d) the student had the opportunity to respond during the delayed trials. Although the initial search revealed 99 articles, only 29 met all inclusion criteria and reflected the Horner et al. (2005) criteria for evidence-based practice. These 29 studies supported the use of time delay as evidence-based practice. This method was incorporated in most of the experimental interventions used in the RAISE studies.

Conceptual Model of Literacy

As part of the iterative process, Browder, et al. (2008) described a conceptual model of literacy for students with severe developmental disabilities. In this model, the primary focus of literacy instruction is for students to gain meaning from literature. We proposed that all young students receive intensive instruction in learning to read and that functional sight word instruction increase in importance as students aged. This model emphasized literature versus functional sight words as the lifelong priority for literacy learning, but with functional sight words becoming more important as students enter the transition years. Our subsequent development of curriculum, interventions, and assessment were based on this model. This model is shown in Figure 1.

Figure 1. A Conceptual Model for Literacy for Students with Severe Developmental Disabilities



Curriculum Development

Early Literacy Skills Builder

As reflected in the comprehensive review of research by Browder et al. (2006), educators were relying heavily on sight word instruction when Project RAISE began in 2004. Sight word instruction, and specifically the *Edmark Reading Program*, became the contrast condition for the future experimental work of this project.

To develop an intervention based on the work of the National Reading Panel (2000), the research team conducted a thorough review of literature on early literacy (e.g., Neuman & Dickinson, 2001; Smith et al., 1998), early literacy programs such as Reading Mastery (Engelmann & Bruner, 2003), and early literacy assessments (Dynamic Indicators of Basic Early Literacy Skills (Good & Kaminski, 2002). From the review of research and other curricula, the research team developed a list of objectives and possible methods and submitted this plan to an expert panel comprised of individuals who had published in the following subject 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. This panel convened in June of 2005 and provided feedback on the list of objectives and proposed methods. The feedback was incorporated into the curriculum and included repeating skills across levels, writing activities, and increased print awareness. A scope and sequence chart with scripted lessons was developed and the resulting curriculum was called the Early Literacy Skills Builder (Browder, Gibbs, Ahlgrim-Delzell, Courtade, & Lee, 2007). Using an iterative process, a first draft was piloted with five teachers. From this pilot, the curriculum was expanded and finalized to include 13 objectives and seven levels. The objectives for the ELSB are shown in Table 1.

Table 1

Early Literacy Skills Builder (ELSB) Objectives

Objective	Rationale – NRP Component
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. (Vocabulary)
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 words. (Vocabulary)
3. Point to words as teacher reads them aloud.	Text pointing promotes the concept of Print: text moves from left to right and top to bottom; each printed word can be spoken. For non-verbal student it may build toward the use of technology support to read aloud. (Concept of Print)
4. Point to or say a word to fill in a repeated story line.	Promotes concept of word and listening comprehension as student fill in missing word. (Comprehension)
5. Respond to a question about the story by selecting correct picture (later lessons-correct word). May answer verbally.	Builds listening comprehension: As students practice text pointing to help “read” the story (see #3), conveys the idea of reading comprehension. (Comprehension)
6. Demonstrate understanding of segmentation by clapping out syllables in words.	Segmenting is a critical component of phonemic awareness; teaches distinguishing by auditory cues including rhythm and stress.
7. Demonstrate understanding of segmentation by tapping out phonemes in CVC words.	Auditorially segmenting sounds in words is the primary precursor in learning to read CVC words. (Phonemic Awareness)

Table 1 (*Continued*)

Objective	Rationale – NRP Component
8. Identify letter-sound correspondence.	Students who are nonverbal (and some with Identify first and last sounds in autism) will need a visual referent to indicate letter sounds. Use of letters themselves may be more efficient than some other concrete referent. (Phonics)
9. Identify first and last sound in words.	Isolating beginning sounds is a critical phonemic awareness skill and a precursor to beginning reading.
10. Find pictures that begin/end with specific sound.	Isolating beginning sounds is a critical phonemic awareness skill and a precursor to beginning reading. (Phonemic Awareness)
11. Point to letters in words that have been segmented.	Blending is one of the most difficult skills to translate for nonverbal students. Voice output devices do not require the student to think about 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. Although more difficult than simple verbal blending, it ensures students are not just "hitting a switch" to say a word. (Phonemic Awareness)
12. Point to pictures that represent segmented words.	
13. Pointing to pictures of spoken words.	Builds conceptual understanding of vocabulary by using a variety of pictures for the same spoken word. (Vocabulary)

Note. NRP = National Reading Panel, CVC = consonant-vowel-consonant

These objectives are taught using a variety of instructional methods including the system of least prompts, time delay, and direct instruction and a script that could be altered to meet the

needs of individual students. In addition to these objectives, the ELSB includes “Building with Stories” which is a task analysis for engaging students in a shared read aloud. Although this component provides instruction for how to adapt literature from the student’s grade level, a supplementary set of adapted books was also created (Zakas & Schrieber, 2010). The ELSB is now endorsed by the Council for Exceptional Children Council for Administrators of Special Education and has been adopted by approximately 800 school systems and 3,000 classrooms nationwide for use with young students with moderate and severe developmental disabilities. More information on the ELSB is contained in the section of this report entitled “Efficacy Studies.”

Pathways to Literacy

In the first two years of Project RAISE, it became clear that some students did not yet have the responses needed to participate in story-based lessons or the skill building objectives of the ELSB. Level A of the ELSB was developed to provide intensive training for students to respond to a read aloud using symbols to show meaning. Some students could move into the ELSB after Level A training. Other students continued to have challenges such as being nonresponsive to the read aloud or not using the assistive technology provided. Educators also wanted options for students who were both visually impaired and intellectually disabled. The curriculum Pathways to Literacy (Lee, Mims, & Browder, 2011) was created to respond to this need. This curriculum includes five levels of instruction that help students progress towards independent responding during read alouds. At the most basic level students learn to select a book and show reactions to the read aloud. At the fifth level, students use symbols to answer comprehension question. More information on Pathways to Literacy is contained in the section of this report entitled “Efficacy Studies.”

Teaching to Standards English Language Arts

By the end of the project, some of the students had moved into middle school. During the last two years of the project, the staff worked to develop a curriculum guide aligned with the general education standard course of study for these grades (Mims, Lee, Zakas, & Browder; in preparation). The curriculum, Teaching to Standards English Language Arts, focuses on adaptations of grade and age appropriate literature (novels, poems, plays) with access across the three difficulty levels of students. Each of four units focuses on a middle school theme (e.g., justice). A pilot study was conducted on this curriculum. Participants included five teachers and 15 middle school students with moderate to severe disabilities. A one-group, nonrandomized, pre-posttest design was implemented to measure vocabulary, comprehension of familiar text and unfamiliar text, poetry, research, and writing skills. Results indicated significant gains in vocabulary and comprehension of familiar text (Browder, et al., in preparation).

Research on Assessment

Curriculum-based Measure: ELSA

One of the challenges of implementing Project RAISE was that a thorough review of current published assessments revealed no acceptable options for use with students who needed to respond using AAC versus speech. The team developed The Early Literacy Skills Assessment (ELSA) as a standardized assessment with scripted administration directions. The ELSA was used during the four years of research on the ELSB as a “near measure” of literacy learning for the ELSB (i.e., exact responses learned in the curriculum). Reliability and validity data on this measure were collected. This data included test-retest reliability, internal consistency and concurrent validity with the TERA-3. The ELSA, received support for building a validity argument including fidelity of administration ($M=95.5\%$), interrater agreement ($M=96\%$),

internal consistency with Cronbach's alpha (.979), and test-retest correlations ($r=.971, p<.001$). The ELSA was also used as a dependent variable in the randomized trials studies. In addition to the ELSA, the ELSB included pre and post-tests for each level that teachers used to determine when to move students to the next level of the curriculum.

Nonverbal Literacy Assessment

The research team also developed the Nonverbal Literacy Assessment (NVLA) as a "far measure" of literacy learning (Ahlgrim-Delzell, Browder, Flowers, & Baker, 2008). Items for the NVLA were generated based on four of the five components of reading (i.e., phonics, phonemic awareness, vocabulary, and comprehension) proposed by the NRP (2000) and on a theoretical model developed by Browder and colleagues. These components were combined to create 221 items based on these six factors of literacy: (a) text awareness, (b) listening comprehension, (c) phonics, (d) phonemic awareness, (e) vocabulary, and (f) comprehension. The NVLA uses a receptive response format with answers provided in two- to four-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 Plexiglas board, (c) pulling the response with cards attached with Velcro to the response book, or (d) verbal answers. 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. Because of the vast differences in student response time and attention, the administration time may vary. Administration time can be approximately 20 minutes per session for a point response to 60 minutes for an eye-gaze response.

During the development of the NVLA, the assessment was reviewed by a panel of experts. Six leaders in the field of literacy, severe disabilities, and assessment were given copies

of the NVLA administration booklet and scoring guide. These individuals examined the (a) representation of the NVLA assessment items to the appropriate factor, (b) the functional importance of the specific items, (c) representation of the NVLA items to the NRP components, and (d) the feasibility of administration to students with severe developmental disabilities. The panel agreed that the items reflected the range of early literacy skills.

The NVLA was piloted by administering it three times during the course of one academic year to 23 students with severe developmental disabilities. No modifications were made to the items; however, the scripted directions were modified to reflect the first year's data. Reliability data included test-retest, fidelity of administration, and internal consistency. Test-retest reliability was conducted by re-administering one session of the NVLA within 1 week of the first administration for 16 students. Test-retest correlation coefficient for the total test score of the NVLA was statistically significant ($p < .001$) at .970. The test-retest correlation coefficients for all of the factors were statistically significant, ranging from .72 to .94. The correlation coefficients among the six factors were statistically significant, ranging from .69 to .97. The mean fidelity of administration was 96.5% with a range of 93.1% to 100%. Internal consistency is high with Cronbach's Alpha at .979.

Item difficulty, content validity and structural validity information was also obtained. The difficulty coefficients were found by finding the mean of each individual item on the NVLA. The difficulty coefficients ranged between .10 to 1.00 with a mean of .32. The NVLA was reviewed by a national panel of experts in June 2006. The expert panel consisted of six researchers in the fields of 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, ensure systematic use of distractors and establishment of basal and ceiling levels.

Baker, Spooner, Ahlgrim-Delzell, Flowers and Browder (2010) conducted a study in which they tested three theoretical models of emergent literacy for students with significant disabilities using confirmatory factor analysis. The first model specification examined the fit of the data to the six factors used to design items for the NVLA. The second model specification tested a two-factor model based on the two sections of the NVLA. The third model specification examined a one-factor global model of literacy. The data from 207 student administrations of the NVLA was used to examine the six-factor model and two alternative models. Results from the analyses suggested that all three models fit the data, but the high correlations coefficients among the constructs suggested that a one-factor model of emergent literacy was the best-fitting model. The NVLA CFA findings are similar to other published assessments of literacy (e.g., *TERA-3*) suggesting high correlations between constructs and observed variables. Past research in reading has found that an integrated, balanced approach (i.e., the teaching of one skill is integrated with the use of another) is needed for teaching students early literacy skills (NRP, 2000). Conclusions from past literacy research currently support the concept of a global construct of literacy on the NVLA.

Common Measures

The research team of Project RAISE also led a collaborative effort with the other IES centers funded to study reading and students with intellectual disability at Georgia State University (GSU) and Southern Methodist University (SMU). This collaborative chose a common set of reading measures to be applied across projects. These data were reviewed annually by a National Advisory Board. The Common Measures included the following

standardized measures: (a) Comprehensive Test of Phonological Processing (CTOPP), (b) Dynamic Indicators of Basic Early Literacy Skills (DIBELS), (c) Test of Word Reading Efficiency (TOWRE), (d) Woodcock Language Proficiency Battery (WLPB), (e) Expressive Vocabulary Test (EVT), and (f) Peabody Picture Vocabulary Test (PPVT).

Common measures outcomes were the submitted to the UNC Charlotte team for 224 students across the three projects. Students were divided into four ability groups based on their pretest performance on the Peabody Picture Vocabulary Test (PPVT). Item sensitivity (difficulty and discrimination coefficients), internal reliability (coefficient α), and concurrent validity coefficients (correlation between all measures) were calculated. The criteria for recommending a measure as having adequate evidence of validity and reliability for interpreting scores for this student population was (a) at least six sensitive items (i.e., a difficulty coefficient of .10 or higher) on the assessment, (b) internal reliability values greater than .80, and (c) concurrent values at .30. The recommendations are shown in Table 2. For Quartiles 2, 3, and 4 (highest 75 percent of students), all the measures met the criteria and are recommended. In Quartile 1 (lowest 25 percent of students), all but one (i.e., Listening Comprehension) language measures met criteria; however only three reading measures were acceptable.

Table 2: Recommended Language and Reading Assessments

	Quartile 1 (Lowest Group)	Quartile 2	Quartile 3	Quartile 4 (Highest)
READING				
CTOPP Total				
Blending Words	✓	✓	✓	✓

Sound Matching		✓	✓	✓
Segmenting Words		✓	✓	✓
TOWRE				
Sight Word Efficiency		✓	✓	✓
Phonemic Decoding		✓	✓	✓
WLPB				
Letter-Word Identification	✓	✓	✓	✓
Passage Comprehension	✓	✓	✓	✓
Word Attack		✓	✓	✓
LANGUAGE				
WLPB				
Memory for Sentences	✓	✓	✓	✓
Listening Comprehension		✓	✓	✓
EVT	✓	✓	✓	✓
PPVT	✓	✓	✓	✓

Growth was examined using effect size coefficients. The formula for the effect size was,

$$ES = \frac{M_{post} - M_{pre}}{SD_{post}},$$

where M_{post} and M_{pre} are the means for posttest (end of school year) and

pretest (beginning of school year), and SD_{post} was the standard deviation for the posttest. A

summary of the effect sizes across all of the language and reading measures for the quartile

groups are shown in Table 3. The darker gray cells indicate large, positive effects (.80 or higher) and the lighter gray cells indicate moderate to small positive effects (.20 to .79). Negative and very small positive effect sizes appear not shaded (.19 or lower). Across all quartiles, effect sizes ranged from -.59 (students scored lower at the end of the school year) to 1.94 (large increase at the end of the school year).

Table 3

Summary of Effect Sizes for Magnitude of Difference between Pretest and Posttest by Quartiles

	Quartiles			
	1 st	2 nd	3 rd	4 th
READING				
CTOPP				
Blending Words Treatment	.30	.65	.63	.86
Blending Words Control	.08	.35	.82	.28
Sound Matching Treatment	.24	.49	.50	.33
Sound Matching Control	.26	.36	.66	.47
Rapid Letter Naming Treatment				
Rapid Letter Naming Control				
Segmenting Words Treatment	.23	.87	.88	.36
Segmenting Words Control	.24	.28	.64	.80
DIBELS				
Nonsense Word Fluency Treatment	.37	.28	1.32	.63
Nonsense Word Fluency Control	-.15	.36	.76	1.56
Word Use Fluency Treatment	.27	.46	.70	.37
Word Use Fluency Control	0	.09	-.82	.40
Oral Reading Fluency Treatment	.29	.34	.80	.41
Oral Reading Fluency Control	-.33	.19	.11	.89

TOWRE

Sight Word Efficiency Treatment	-.04	.61	.12	.16
Sight Word Efficiency Control	.08	-.06	-.05	-.71
Phonemic Decoding Treatment	.44	.74	.89	.74
Phonemic Decoding Control	.24	.70	1.26	1.18

WLPB

Letter-Word Identification Treatment	.55	.92	1.05	.67
Letter-Word Identification Control	.47	.62	1.07	.53
Passage Comprehension Treatment	.71	.87	1.23	.65
Passage Comprehension Control	.11	.39	1.30	1.05
Word Attack Treatment	.41	.27	1.34	.77
Word Attack Control	.09	.21	.81	.89

LANGUAGE**WLPB**

Memory for Sentences Treatment	.44	1.94	.87	.38
Memory for Sentences Control	.09	.31	.28	.36
Listening Comprehension Treatment	-.08	.82	1.44	.75
Listening Comprehension Control	.30	.72	.80	.60
EVT Treatment	.51	.76	.67	1.25
EVT Control	.20	.40	.85	.59
PPVT Treatment	.96	.90	1.46	-.01
PPVT Control	.64	.37	.55	.40
Average Effect Size	.26	.54	.76	.59

Research on the RAISE Interventions

Research on the Early Literacy Skills Builder

Research on the ELSB began with a randomized trials study that was implemented during the 2005-2006 school year with 23 students (Browder, Ahlgrim-Delzell, Courtade, Gibbs, & Flowers, 2008). Students were stratified by type of disability (autism, moderate MR, severe MR) and then randomly assigned to either the treatment ($N=11$) or control ($N=12$). Treatment students received all components of the ELSB curriculum, including the intense training in phonemic awareness. The control students only received the story-based lessons (read alouds) and additional sight word/ picture identification training (no PA training). Training was conducted by the classroom teachers in either 1:1 or small group settings. Teachers were trained in a workshop format and then monitored for procedural fidelity throughout the school year. Teachers' fidelity of administration was overall good (mean of 85% for Sounds & Symbols, 93% for Stories.) Students in the ELSB not only had significantly higher posttest scores for the ELSA (curriculum-based measure), but also for the NVLA (a far measure) for phonic/phonemic awareness.

Two additional cohorts were added to the study in the subsequent two years and the data were again analyzed (Browder, Ahlgrim-Delzell, Flowers, & Baker, in press.) In this replication, there were 93 students who received the ELSB for either 1, 2, or 3 years and who participated in that year's posttesting. Those numbers reflected attrition of 16 students. Implementation fidelity for Edmark, the comparison condition, was 97.78%. Implementation ELSB fidelity across all three years of the study was 94.02%. Multivariate analysis of covariance (MANCOVA) was used to examine the effects of the intervention on the combination of three measures of literacy: Conventions of Reading, Phonics Skills, and Peabody Picture Vocabulary Test (PPVT). The first two measures were the two subtests of the NVLA. Pretest literacy measures were used as

covariates to help reduce the error variance. In addition to the treatment effect, the independent variable of cohort (i.e., the year the student entered the experiment) was included in the analysis to help reduce error variance. A 2 X 3 multivariate analysis of covariance (MANCOVA) was conducted with the independent variables of reading intervention (treatment and control groups) and cohort (first, second, or third year entry into the study). A one-tailed Wilks' criterion test was used to determine statistical significance. Results indicated that there was a statistically significant omnibus main effects for treatment, $F(2, 82)=3.07, p=.012, \eta_p^2=.07$, year of study, $F(4, 164)=4.82, p=.001, \eta_p^2=.11$, but there was not a statistically significant group by cohort interaction, $F(4, 164)=.65, p=.630, \eta_p^2=.01$. Because three years of data supported higher gains for the experimental group receiving the ELSB, in the final intervention year all students received the ELSB.

Over the four years of RAISE, 22 transitioned from the ELSB to Reading Mastery in 1-3 years. At the end of data collection the participants ended in the following levels: (a) 28 students graduated to Reading Mastery; (b) 7 at Level 7; (c) 7 at Level 6; (d) 12 at Level 5; (e) 6 at Level 4; (f) 13 at Level 3; (g) 20 at Level 2; and (h) 11 at Level 1. Additionally, 20 students received instruction in Level A.

Research on Pathways to Literacy

Students who needed the Pathways to Literacy intervention were a small subgroup of students for whom a randomized trials experiment would not be feasible. Instead, this study was evaluated with a series of single case studies. Browder, Mims, Spooner, Ahlgrim-Delzell, and Lee (2009) used a multiple probe across participants design to evaluate methods for providing literacy instruction to three students with severe intellectual and physical disabilities. The intervention included using a team approach to apply components of Universal Design for

Learning to plan literacy instruction for each student. Results indicated that all three students gained foundational literacy skills such as choosing a book, focusing on objects related to the story or using a voice output device to complete a repeated storyline.

In a follow up study, Mims, Browder, Baker, Lee, and Spooner (2009) used a least-to-most prompting system to teach listening comprehension during shared stories to two elementary school students with severe intellectual disability, physical disabilities, and visual impairments. A multiple probe design across materials showed that both students improved comprehension over the three books.

In a third study, Browder, Lee, and Mims (in press) used scripted literacy lessons with students with significant disabilities and visual impairment. A multiple probe design across response modes was used to evaluate the impact of individualized scripted instruction on students' level of engagement in literacy and students' abilities to answer literal comprehension questions. Results of the study showed that all three students reached the 80% mastery criteria suggesting that individualized scripts can be effective in increasing comprehension and engagement for students with significant disabilities.

The full Pathways to Literacy curriculum package was derived from these three studies and then field tested with 9 students with severe disabilities in the Charlotte Mecklenburg School System. All nine students made progress and moved up at least one level during a school year. Two mastered the fifth level and moved into the ELSB.

Other Published Studies on Literacy Learning

Two additional studies conducted in Project RAISE explored other aspects of the story-based lesson intervention. Spooner, Rivera, Browder, Baker, and Salas (2009) considered how to make these read alouds more culturally responsive. A 14 step task analysis was taught using

forward chaining, but also within the context of cultural contextual story selected by the paraprofessional who was Latina. The student mastered the steps of the task analysis. Additional information from the paraprofessional described how she helped the student transition from Spanish to English in the read alouds.

Mims, Browder, & Spooner (2010) implemented a shared story with a specific focus on teaching listening comprehension. A system of least prompts intervention was evaluated via a multiple probe design across books with a concurrent replication across four students. Outcomes indicated that all four students increased the number of comprehension questions correctly answered during each book.

In a study that considered students who needed further language instruction, Hicks, Stevenson, Wood, Cooke, and Mims (in press) examined the effects of Direct Instruction on the acquisition of prepositions by students with moderate intellectual disabilities. A multiple baseline design across prepositions was used to evaluate the effects of the Direct Instruction intervention on two participants' comprehension of and response to locative prepositions. Results of this study showed that Direct Instruction was an effective method of teaching prepositions to students in this population.

Studies on Impact and Scale Up

Survey

In the final year of Project RAISE, the ELSB was brought to scale in the Charlotte-Mecklenburg school (CMS) system. The curriculum was adopted by the local Board of Education and became the primary method of reading instruction for students with significant disabilities in the fall of 2009. A scale up survey was developed and disseminated to 72 special educators in the CMS school district who taught students with significant disabilities. Interviews

with district-level administrators, elementary school principals, and special education teachers who had implemented the ELSB were conducted to identify factors that impact scale-up of a curriculum for this population. Information gathered through the interviews was used to develop the survey. This survey was designed to gather feedback about the curriculum and access impact factors that contribute to continued implementation of the ELSB that had been identified in the interviews. These interviews found the following seven potential factors to impact scale-up of the ELSB curriculum: (a) preparation, (b) implementation, (c) support, (d) adaptations, (e) outcomes, (e) administrator involvement, and (f) parent involvement. The survey was disseminated in spring 2009 with a response rate of 77.3%. On a scale from 1 (least helpful) to 10 (most helpful) respondents rated the components of the ELSB training sessions as a measure of impact of preparation. The following training components were rated at least an 8: (a) trainer demonstration (80%), (b) demonstration of adaptations (77.7%), (c), video demonstration (80%), and (d) feedback by the Literacy Specialist (77.7%). Student outcomes provided motivation for continued implementation of the ELSB in the following areas increase in literacy skills (84.4%), increased participation in instruction (75.6%), student enthusiasm (71.1%) and increased student attention (62.2%). Support for implementation came from availability of premade curriculum materials (84.4%), collaboration with other teachers (75.6%), and visits by the Literacy Specialist (68.9%). Ease of providing adaptations was a key factor in continuing to implement the ELSB. Adaptations included those for student responses such as an eye gaze board (28.9%) and voice output device (77.8%) and instructional adaptations such as shortening the script (55.6%) and dividing the lessons into smaller sessions (51.1%). Teachers rated student progress as high, moderate and low. Forty-two percent of the teachers rated student progress on Building with Phonics as high, 47.5% rated student progress on Building with Stories as high, while

Individualized education plan	0	0	0	2	8	1	5	2	0	5	3	0	4	0	1	0	0	0	1	0
Edmark	16	0	2	3	3	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0

Component	n	Minimum	Maximum	Mean	SD
ELSB phonics	41	0	275	104.39	69.02
ELSB stories	41	0	200	94.61	48.82
Reading Mastery	37	0	300	48.65	75.13
Sight Words	37	0	225	58.78	46.98
IEP	41	20	450	232.80	146.98
Edmark	34	0	150	34.56	46.96
Other	8	0	225	87.5	84.52

As part of the qualitative study conducted in the final year of RAISE, some Charlotte-Mecklenburg school administrators were interviewed on the system-wide scale-up of RAISE. This group included administrators at the district and school levels. When asked about any issues they were aware of with the scale-up, some of the responses included the concern of balancing instructional time in the classroom and ensuring fidelity of implementation. When asked if they had received any negative feedback from the teachers, none of the principals had received any and each administrator had only positive things to say about the ELSB. Several administrators also indicated that professional development was imperative in the successful scale up of the curriculum and that to maintain the success, coaching may be necessary.

Video Study on Impact

In the fall of 2010, a study was conducted to evaluate the overall impact of Project RAISE in the Charlotte Mecklenburg School System. Hicks, Rivera, Browder, and Flynn (in preparation) compared videos of teacher literacy instruction recorded in 2004 and 2010. The 2004 videos were recorded prior to implementation of RAISE as part of an earlier project. On

each occasion teachers were asked to allow the team to video record a literacy lesson of their choosing. Coding focused on NRP components and the National Early Literacy Panel (2008) components that were strong indicators of future reading performance for students. Preliminary results showed that teachers, prior to participating in RAISE, taught sight words and had students practice counting during morning calendar time. After the intervention, teachers provided more opportunities for students to respond to comprehension questions, phonics instruction, print concepts, phonological memory and sight word instruction.

Video Ethnography

A qualitative study using video ethnography and interviews was conducted with six teachers who taught literacy to students with moderate and severe disabilities using the ELSB (Ahlgrim-Delzell, Taylor, & Rivera, in preparation). Initial conclusions from this study suggest that teachers who implement the ELSB with fidelity and utilize good instructional decision-making that included prompting and reinforcement strategies that are individualized for student needs were associated with higher student engagement and fewer challenging behaviors. Additional factors that appeared to impact student behavior and response to instruction were differential expectations for students within the group and response systems that matched student needs.

Adaptive Behavior

Finally, the Vineland Scales of Adaptive Behavior were used to compare scores after one year of ELSB intervention for the three original experimental and comparison cohorts. Although a repeated measures ANOVA revealed no significant differences between groups, Cohen's *d* had greater gains for the treatment group on seven of the nine subscales favor when compared to the control group (See Table 5).

Table 5

Cohen's d Effect Size for Vineland Subscales

Vineland Subscale	Treatment	Control
Receptive	.29	.07
Expressive	.05	.08
Written	.31	.45
Personal	.14	.05
Academic	.34	.26
School Community	.24	-.02
Interpersonal Relationships	.23	.21
Play and Leisure Time	.28	.12
Coping Skills	.28	.14

Examples of Student Outcomes

Most students referred to Project RAISE received the ELSB. Every student showed progress of mastery of at least one lesson or level. In contrast, some students did not have the response consistency to participate in the assessments for the ELSB. Pathways to Literacy was developed for students at the lower spectrum of beginning ability. For example, Brady was a student with a severe intellectual and physical disability. Brady began his participation in Project RAISE with no clear responses to a read aloud and no use of symbols to communicate. Through completion of all five levels of Pathways to Literacy, Brady was able to open a book, turn the page in a book, feel objects on the page that represent an idea in the story, and make predictions regarding what the story might be about. He also demonstrated success in comprehension by anticipating a repeated story line, completing the line using assisting technology and answering literal comprehension questions from a choice of two pictures representations. At the end of Project RAISE, Brady was a candidate for the ELSB.

At the opposite end of the spectrum were students who began their participation in Project RAISE in the ELSB, mastered all seven levels of the ELSB, and then continued to make progress as beginning readers with Reading Mastery. These early reading students had also

outgrown the story-based lessons. Their teachers began to use shared readings in which the student read a part of the passage and the teacher read the other part. For example, the student Kaitlin progressed through all levels of the ELSB. Although Kaitlin had limited speech when she began the ELSB, she could articulate clearly enough to participate verbally by the time she entered Reading Mastery. Kaitlin also independently read aloud short passages in the shared reading and answered comprehension questions by choosing between words or pictures.

Summary

The U.S. Department of Education IES funded Project RAISE created the opportunity for over 100 students in the Charlotte Mecklenburg School System to make gains in early literacy. Over 25% of these students had read and comprehend short passages by the time the project ended. The project produced two published curricula. The Early Literacy Skills Builder which was published in 2008 is now being used nationwide for students with moderate and severe developmental disabilities. Pathways to Literacy will be in print in early 2010. The project also produced several studies on early literacy including one of the first evaluations of a comprehensive early literacy curriculum (Browder et al., 2008; in press). The project also contributed to understanding how to assess reading for students with intellectual disability, how to bring literacy instruction to scale in a large urban school system, and how to engage students with multiple disabilities in read alouds.

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