

Implications of Utilizing a Phonics-Based Reading Curriculum With Children Who Are Deaf or Hard of Hearing

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Extensive literature has reiterated the reading difficulties of students who are deaf or hard of hearing. Building and expanding upon the work of B. J. Trezek and K. W. Malmgren (2005), this study demonstrated that given 1 year of instruction from a phonics-based reading curriculum supplemented by Visual Phonics, kindergarten and first-grade students who were deaf or hard of hearing could demonstrate improvements in beginning reading skills as measured by standardized assessments of (a) word reading, (b) pseudoword decoding, and (c) reading comprehension. Furthermore, the acquisition of beginning reading skills did not appear to be related to degree of hearing loss. In this study, students with various degrees of hearing loss benefited equally well from this phonics-based reading curriculum supplemented by Visual Phonics.

Despite a few exceptions, it has been documented since the beginning of the formal testing movement in the early 1900s that many students who are deaf or hard of hearing do not read as well as their hearing peers. It has been reported that the average 18- to 19-year-old deaf student is reading at a level commensurate with the average 8- to 9-year-old hearing student (Paul, 1998; Pintner & Patterson, 1916; Traxler, 2000). In addition, compared to the roughly 1 year grade level gain for many hearing students, the annual growth rate for many deaf and some hard-of-hearing students appears to be about a 2–3 month gain, and the growth does not progress steadily from year to year (Allen, 1986; Trybus & Karchmer, 1977).

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Paul (1998, 2001, 2003) systematically categorized the risk factors for students who are deaf or hard of hearing into text-based factors, reader-based factors, task-based factors, and context-based factors. One of the most controversial areas is identification of the perceptual units in working memory processes; that is, whether skilled readers use whole words or subword-level units such as phonemes, syllables, or letters as the units of perception in their working memory processes. In this vein, the reading problems of individuals who are deaf or hard of hearing may be closely connected with the failure to appropriately address the phonological components of reading instruction (Leybaert, 1993), particularly phonemic awareness and phonic skills. These two skills have been widely recognized as the means to enhance decoding skills among hearing readers (Adams, 1990; Chall, 1996; National Reading Panel [NRP], 2000; Snow, Burns, & Griffin, 1998).

Drawing from the summary report of the National Reading Panel, *Put Reading First—The Research Building Blocks for Teaching Children to Read Kindergarten through Grade Three* (Armbruster, Lehr, & Osborn, 2001), phonemic awareness is defined as “the ability to notice, think about, and work with the individual sounds in spoken words” (p. 2) and phonics as “the understanding that there is a predictable relationship between phonemes (the sounds of *spoken* language) and graphemes (the letters and spellings that represent those sounds in *written* language)” (p. 4). It is not surprising that students who are deaf or hard of hearing

are at risk for acquiring sufficient decoding skills due to their limited access to and instruction focused on the phonological aspects of the English language (e.g., phonemic awareness and phonics).

Although we acknowledge that these skills are only two of the five areas of reading instruction recommended by the NRP (2000) along with fluency, vocabulary, and comprehension, the limited number of studies that have focused on these potentially critical components of instruction for deaf and hard-of-hearing readers certainly warrants attention. Therefore, in this investigation, we chose to focus primarily on the acquisition of phonemic awareness and phonics skills and explore the relationship between these skills and improvements in reading comprehension among young children who are deaf or hard of hearing.

In the field of deafness, the role of phonology in the acquisition of reading abilities has been explored, and research evidence suggests that the ability to use phonological information while reading is what distinguishes skilled readers from average and poor readers (Conrad, 1964; Engle, Cantor, & Turner, 1989; Hanson, 1982; Hanson & Fowler, 1987; Hanson, Goodell, & Perfetti, 1991; Hanson & Lichtenstein, 1990; Kelly, 1993; Leybaert, 1993; Musselman, 2000; Perfetti & Sandak, 2000). To hear the phonemes and articulate them properly is not considered critical; rather, the major goal is to understand that phonemes are the building blocks of language and to develop the ability to manipulate them (Adams, 1990; Hanson, 1989).

In a recent comprehension review of reading research for students who are deaf or hard of hearing, Schirmer and McGough (2005) indicated that intervention research evaluating the effectiveness of phonological instruction for students is extremely limited. In their review, the authors also suggested that future reading interventions with students who are deaf or hard of hearing “should investigate the instructional practices found to be effective with normally achieving and disabled readers” (p. 111).

Since the publication of Schirmer and McGough’s (2005) review, one such intervention study has been published evaluating the efficacy of utilizing a phonics treatment package with middle-school-age students who are deaf or hard of hearing. The results of this study indicated that students receiving instruction

from a phonics-based reading curriculum supplemented by Visual Phonics (International Communication Learning Institute [ICLI], 1996), a system of moving hand cues, and computer technology significantly outperformed their comparison group peers on measures of word reading and pseudoword decoding (Trezek & Malmgren, 2005). The phonics-based reading curriculum employed in this study was the Direct Instruction Corrective Reading-Decoding curriculum. Research findings have documented the effectiveness of the Decoding series with remedial readers (Campell, 1988; Gregory, Hackney, & Gregory, 1982), noncategorical poor readers (Holdsworth, 1984–1985; Kasendorf & McQuaid, 1987), and special education students (Thompson, 1992; Thorne, 1978).

The Reading Mastery I program (Engelmann & Brunner, 1995) is the first level of the Direct Instruction basal reading series designed to teach reading skills to students beginning in kindergarten. A significant number of research studies have documented the effectiveness of the phonemic awareness and phonics components included in the Reading Mastery I curriculum with children in kindergarten and first grade (Adams, 1990; Anderson, Hiebert, Scott, & Wilkinson, 1985; Chall, 1983; Stahl & Miller, 1989; Stanovich, 1994). In addition, in a review of 21 studies comparing the Reading Mastery curriculum to other reading programs utilized with general education, general education remedial and special education readers, the Reading Mastery program was favored in 14 (67%) of the studies. Other reading programs were favored in 3 studies (14%), and no statistically significant difference was reported in 4 (19%) of the reviewed studies (Schieffer, Marchand-Martell, Martell, Simonsen, & Waldron-Soler, 2002). Despite the success of utilizing the Reading Mastery curriculum with a variety of students, no published research investigations have explored the effects of using these instructional strategies with young children who are deaf or hard of hearing.

This study intended to evaluate the effectiveness of utilizing the Reading Mastery I curriculum (Engelmann & Brunner, 1995), supplemented by Visual Phonics (ICLI, 1996), with kindergarten and first-grade students who are deaf or hard of hearing. This inquiry was led by the following research question: Given 1 year of instruction from a phonics-based reading

curriculum supplemented by Visual Phonics, can kindergarten and first-grade students who are deaf or hard of hearing demonstrate improvements in beginning reading skills as measured by standardized assessments of (a) word reading, (b) pseudoword decoding, and (c) reading comprehension?

Method

Participants and Setting

The Hearing Impaired program that was utilized for this study is housed in a large, urban, school district in a Southern state. This self-contained program for students who are deaf or hard of hearing served approximately 75 students in preschool through fifth grade during the school year in which the study took place. Three elementary school teachers in the Total Communication program serving students in kindergarten and first grade were recruited for this research project. Sixteen students were included in the study at pretest; however, due to various circumstances (e.g., student moved, students absent for posttest) the analysis was based on the 13 students retained over the 8-month intervention period.

Convenience sampling was utilized in this study; therefore, students were placed in three cohorts based on their classroom placement. Student Participants 1–4 comprised Cohort 1 and were enrolled in kindergarten with an average age at the onset of the study of 5 years, 6 months. Cohort 2 students, Participants 5–8, were placed in a first-grade classroom with the average age of participants being 6 years, 1 month. Finally, Student Participants 9–13 made up Cohort 3 and were also enrolled in first grade with a 7 year, 3 month, average age at the onset of the study.

Information regarding ethnicity of students was obtained from the annual enrollment form completed by parents at the beginning of the school year. Of the 13 student participants, 54% ($n = 7$) were reportedly African American and 46% ($n = 6$) Hispanic. The degree of hearing loss was obtained from the students' most recent audiological evaluation on file at the school. Student participants had varying degrees of hearing loss ranging from severe to profound with 2 of the first-grade students using cochlear implants.

See Table 1 for a summary of degree of hearing loss, age, and grade placement for participants.

All three teachers held Pre-K through 12 state Hearing Impaired certification. In addition to her Hearing Impaired certification, the teacher of students in Cohort 1 also held certification in Special Education. This teacher had a Bachelors of Science degree and 6 years of teaching experience at the beginning of the study. The teacher of students in Cohort 2 had a Masters degree, additional certification in Elementary Education Grades 1–6, and 29 years of teaching experience at the onset of the study. The teacher of students in Cohort 3 also had 29 years of teaching experience, a Bachelors of Science degree, and held Elementary and English certification for Grades 1 through 8 and Pre-K through 12 certification in English as a second language in addition to her Hearing Impaired certification. This teacher also served as the Reading and Language Arts lead teacher for the elementary Hearing Impaired program during the school year in which the study took place. Two of the teachers reported their ethnicity as Caucasian and the third Asian/Pacific.

Procedure

Teaching materials. The Direct Instruction Reading Mastery I curriculum served as the curricular base for this intervention study. This program is characterized as a systematic, explicit phonics curriculum created to teach beginning reading skills to students in kindergarten and first grade. The design of the Reading Mastery I curriculum is based on Siegfried Engelmann's theory of instruction. According to Engelmann, learning can be greatly accelerated when instructional presentations are clear, carefully sequenced, and when the specific skills taught foster generalization to novel learning situations (Marchand-Martell, Slocum, & Martell, 2004).

The scripted teacher presentation manuals, the hallmark of the Direct Instruction programs, have been extensively field tested and revised to ensure that teachers can convey the intended information to students in a clear, concise, and effective manner. Furthermore, the teacher scripts provide consistency of instruction from lesson to lesson and teacher to

Table 1 Summary of hearing loss, age, and grade placement for participants ($N = 13$)

Student number	Degree of hearing loss (pure tone average in better ear)	Age at onset of study (year/months)	Grade placement
1	82 dB	5.9	K
2	88 dB	5.5	K
3	112 dB	5.11	K
4	88 dB	5.9	K
5	108 dB	6.11	1
6	CI	6.1	1
7	120 dB	6.1	1
8	82 dB	6.0	1
9	85 dB	7.9	1
10	100 dB	7.11	1
11	95 dB	6.9	1
12	CI	7.0	1
13	120 dB	7.7	1

Note. CI = student utilizes a cochlear implant; K = kindergarten; 1 = first grade.

teacher. In addition to its unique curricular design, the Direct Instruction programs employ specific teaching strategies such as achievement-based grouping, small group instruction, fast-paced lessons, frequent unison responding, and careful monitoring of individual progress (Carnine, Silbert, Kame'enui, & Tarver, 2004; Marchand-Martell et al., 2004).

The 160 lessons of the Reading Mastery I curriculum are divided into three sections, with each section focusing on the development of both decoding and comprehension skills. Section 1 of the curriculum, Lessons 1–27, are considered prereading lessons in which the students learn sound pronunciations, sequencing, oral blending, rhyming, and symbol identification to enhance their decoding skills. In this section of lessons, students also receive instruction focused on picture comprehension and sequencing events as a means of developing comprehension skills (Engelmann & Brunner, 1995).

Lessons 28–74 comprise the second section of the Reading Mastery I curriculum. In this group of lessons, students continue to receive decoding instruction centered on symbol identification, but reading vocabulary and story reading are also added. In the third section of the curriculum, Lessons 75–160, the above decoding skills continue to be the focus, but individual assessments of reading fluency are also added. During Lessons 28–160, comprehension of vocabulary words, oral comprehension questions, picture comprehension, written comprehension activities,

and comprehension games are utilized to develop students' comprehension skills (Engelmann & Brunner, 1995). It is important to note that the skills addressed in this curriculum, phonemic awareness, phonics, fluency, vocabulary, and comprehension, are aligned with the five areas of beginning reading instruction recommended by the NRP (2000) and those consistently related to reading achievement among hearing children.

During the 8-month duration of the study, students in the study received instruction from various sections of the Reading Mastery I curriculum. The variation in instruction was based on students' cohort placement and previous instruction in the curriculum. Students in Cohort 1 received instruction from Lessons 1–50, students in Cohort 2 began instruction with Lesson 51 and completed Lesson 108 by the end of the study, whereas students in Cohort 3 started receiving instruction with Lesson 112 and ended with Lesson 148. Averaged across the three cohorts, students received 48 lessons of instruction from the Reading Mastery I curriculum over the 8-month period.

Visual Phonics. Although speechreading and articulatory feedback have been identified as possible alternative means of gaining access to phonological information for deaf and hard-of-hearing individuals (Hanson, 1989; LaSasso, 1996; Leybaert, 1993), a potential problem in utilizing these strategies alone is that a particular mouth movement can represent more

than one phoneme (e.g., /p/, /b/, and /m/) and some phonemes are not visible on the lips (e.g., /k/ and /g/), thereby resulting in an incomplete or ambiguous representation (Alegria, 1998; Leybaert, 1998). Cued Speech (Cornett, 2000) and Visual Phonics (ICLI, 1996) are two systems that have been created to represent the phonemes of English language using the manual mode.

There are several similarities between Cued Speech and Visual Phonics. First, both systems utilize a specified handshape or cue to represent each phoneme of the English language. Second, speechreading and articulatory feedback are often used with both systems to provide additional information to students regarding phonemes (Cornett, 2000; Waddy-Smith & Wilson, 2003). Finally, both Cued Speech and Visual Phonics can be utilized in conjunction with a traditional sign language system to educate deaf and hard-of-hearing students.

Although there are several similarities between the two systems, there are differences that distinguish the two systems from each another. First, Visual Phonics uses hand cues and written symbols to represent individual phonemes, whereas Cued Speech uses hand shapes in different placements near the mouth to represent syllables rather than individual phonemes. Second, the hand cues in the Visual Phonics system were designed to provide users with information about speech production, whereas those in Cued Speech were not. For example, the Visual Phonics hand cue for the /m/ sound is produced by holding a flat, closed hand horizontally near the mouth and moving the hand forward in a waving motion to represent the vibrating nature of this phoneme. Finally, Visual Phonics is to be utilized as only as a phoneme representation system whereas Cued Speech is intended to be used as a communication system (Cornett, 2000; Waddy-Smith & Wilson, 2003).

The decision to use Visual Phonic to supplement the phonics instruction provided through the Reading Mastery I curriculum was based primarily on the fact that the teachers had received training and were using the Visual Phonics system prior to the onset of this intervention study. In addition, a previous research investigation had demonstrated the efficacy of employing Visual Phonics to support the implementation of

a Direct Instruction reading program with students who are deaf or hard of hearing (Trezek & Malmgren, 2005). Although written symbols are also part of the Visual Phonics system, only the hand cues were employed as part of this intervention.

Teacher training. The three teacher participants attended a 6 hour Visual Phonics training session in October 2002. The Direct Instruction Reading Mastery I program was adopted as the school's basal reading program for students in kindergarten and first grade in January 2003. The first author served as a consultant for this implementation, providing an initial training in the Reading Mastery I curriculum and monthly observations of classroom instruction during the first semester of implementation. During the 2003–2004 school year, these teachers continued to utilize the Reading Mastery I program with students and received quarterly consultation and observations from the first author.

At the onset of this study, each teacher had been using the Reading Mastery I curriculum and Visual Phonics with students for three semesters. As with the previous year, quarterly consultation and observations were provided by the first author throughout the duration of the study.

Measures. The Wechsler Individual Achievement Test-II (WIAT-II; Psychological Corporation [PC], 2002) was the standardized test used as a pre–post test measure of students' reading achievement. According to the administrative procedures of this test, students in kindergarten ($n = 4$) are administered only the Word Reading subtest, whereas the reading skills of students in first grade ($n = 9$) are assessed using three subtests: Word Reading, Pseudoword Decoding, and Reading Comprehension.

The Word Reading subtest assesses the ability to name letters, recognize and produce rhyming words, identify words with the same beginning and ending sounds, blend sounds to form words, match letters to their corresponding sounds, and read words from a list. For the Pseudoword Decoding subtest, students are required to decode nonsense words. The 30 pseudowords contain various phonetic elements including regular words with consonant–vowel–consonant

patterns, beginning and ending blends, vowel combinations, r-controlled vowels, multisyllabic words, and those that follow the silent-e rule. For first-grade students, items on the Reading Comprehension subtest range from reading single words and matching them to a picture to reading a 110-word passage and answering five comprehension questions about what was read.

Individual administration and scoring of the WIAT-II (PC, 2002) was conducted by the first author who was previously trained in administering the WIAT-II and spent 4 years training graduate and undergraduate students to administer this assessment. In addition, the first author is a licensed Visual Phonics trainer and a certified teacher of the deaf and hard of hearing with 10 years of teaching experience, 5 of which included assessing the phonics skills of deaf and hard-of-hearing students. This individual has also conducted trainings on utilizing Visual Phonics in conjunction with the Direct Instruction reading programs and has served as a consultant for several curricular implementations.

All test items were administered to students using speech and sign language simultaneously. Decisions regarding when to use Visual Phonics, simultaneous communication (speech and sign), or a combination of both during test administration were consistent with instructional practices used by teachers. For example, teachers typically paired simultaneous communication with the corresponding Visual Phonics cues during any instructional activity that required students to manipulate and/or identify individual phonemes in a word. Therefore, when asked to identify words with the same beginning sound on the WIAT-II, a similar procedure was employed. On the other hand, teachers used simultaneous communication alone when asking comprehension questions during lesson presentations; therefore, this strategy was replicated during testing situations.

Students who utilized a hearing aid, assistive listening device, or cochlear implant as part of their school programing were asked to use the same device(s) during test administration. Students responded to test items using a combination of signs, fingerspelling, vocalizations, and Visual Phonics cues that were consistent with responses provided during instructional sessions. If students elected to produce vocalizations

during the Word Reading and Pseudoword Decoding subtests, the correct vocal sensation (voiced vs. unvoiced) had to be used in conjunction with the Visual Phonics cue in order to receive credit for the response. For example, when decoding the pseudoword *pon*, the student would be required to provide three distinct cues and produce an unvoiced response for the /p/ sound, a voiced sound for /o/, and a nasal sound for /n/. If vocalizations were not included in the response, the correct mouth movement needed to be used in combination with the Visual Phonics cues. In addition to the first author's test administration, the Reading and Language Arts lead teacher observed 38% of the test administration to ensure procedural reliability and accuracy of scoring.

Fidelity of implementation was monitored using teacher log sheets and quarterly observations. The three teachers were asked to log the number of lessons completed and observations of students' progress and acquisition of skills. Quarterly observations were conducted by the first author. Specific observations of teaching techniques and use of Visual Phonics cues as well as suggestions for improving instruction were noted in narrative form. The information collected during each observation was shared and discussed with each teacher the day the observation occurred.

Analysis. The raw scores of Word Reading obtained at pre-post test for each student ($N = 13$) were analyzed using a paired-sample t test (two-tailed), and the raw scores of Pseudoword Decoding and Reading Comprehension for the first-grade students ($n = 9$) were analyzed by their descriptive statistics. Furthermore, the annual gain of the sample ($N = 13$) was compared with the annual growth rate of the national population. Finally, bivariate correlations between degree of hearing loss and performance on test measures were also conducted (Table 2).

Results

The pretest raw scores in Word Reading for all participants ($N = 13$) ranged from 26 to 45 ($M = 33.92$, $SD = 7.100$), whereas the posttest raw scores ranged from 37 to 61 ($M = 45.62$, $SD = 7.523$). A paired-sample t test (two-tailed) was employed to calculate

Table 2 Summary of subtest raw scores for participants ($N = 13$)

Student number	Word Reading		Pseudoword Decoding		Reading Comprehension	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
1	26	37	NA	NA	NA	NA
2	26	37	NA	NA	NA	NA
3	27	37	NA	NA	NA	NA
4	35	41	NA	NA	NA	NA
5	29	43	2	12	5	11
6	29	46	2	11	5	10
7	27	40	0	2	7	7
8	34	45	1	11	2	13
9	40	54	4	17	11	14
10	39	51	3	9	9	17
11	45	53	10	13	9	19
12	45	61	10	15	17	21
13	39	48	9	10	10	14

Note. NA = not available.

the difference between the Word Reading scores obtained on the pretest and the posttest scores. The results of the analysis indicated that there was a statistically significant difference ($t = -13.514$, $p = .000$) between the pretest scores and the posttest scores on Word Reading. Cohen (1988) defined effect sizes as small when $d = .2$, medium when $d = .5$, and large when $d = .8$. The calculated Cohen's d on participants' Word Reading pretest and posttest scores showed that $d = -1.600$. This means that the average pretest scores would be 1.600 standard deviation lower than the average posttest scores in terms of Word Reading and therefore the effect size is considered large.

As for Pseudoword Decoding and Reading Comprehension, the limited available data ($n = 9$) were not appropriate for a statistical test such as the t test. However, when we examined the sample descriptive statistics of the pretest ($M = 4.56$, $SD = 4.003$) and the posttest ($M = 11.11$, $SD = 4.226$) for Pseudoword Decoding, it was obvious that the participants outperformed on the posttest. Accordingly, the sample descriptive statistics for the pretest ($M = 7.89$, $SD = 4.676$) and the posttest ($M = 14.00$, $SD = 4.444$) on the Reading Comprehension subtest showed a similar pattern.

Using the participants' raw scores on the WIAT-II (PC, 2002), we calculated the grade equivalent gain for each dependent measure. The sample's average annual

gain on Word Reading ($N = 13$) calculated by grade equivalent was 4.33 months. The first-grade participants' ($n = 9$) average annual gain on Pseudoword Decoding calculated by grade equivalent was 9 months. Although gains in raw scores were noted for all but one first-grade participant ($n = 9$) on the Reading Comprehension subtest, it was not possible to report a grade equivalent gain for this particular subtest. According to the standardization manual of the WIAT-II, both the average pretest and posttest scores for this subtest had reported grade equivalents of <1.0 . Unfortunately, the standardization information included with this test measure was not sensitive enough to capture grade equivalent gains made by the first-grade students on the Reading Comprehension subtest. However, compared to the 2–3 month annual growth rate for the national population of students who are deaf or hard of hearing (Allen, 1986; Trybus & Karchmer, 1977), our participants performed better on the Word Reading and particularly the Pseudoword Decoding subtests.

An analysis was also conducted to determine if there was a correlation between degree of hearing loss and students' gain on Word Reading from the treatment. Correlations were calculated for each student's unaided Pure Tone Average in the better ear and their difference scores (posttest scores – pretest scores) on Word Reading ($N = 13$). The analysis revealed that there was no statistical significance between degree of

hearing loss and the gain on Word Reading from the treatment when the alpha level was set at .05 ($r(13) = -.545, p = .054$). In other words, with regard to Word Reading, students with more significant hearing losses benefited equally well from the treatment as those students with less significant hearing losses.

Discussion

The purpose of this study was to assess the efficacy of utilizing the Reading Mastery I curriculum (Engelmann & Brunner, 1995) supplemented by Visual Phonics (ICLI, 1996) with kindergarten and first-grade students who are deaf or hard of hearing. The following research question was developed to assess the effectiveness of the implementation: Given 1 year of instruction from a phonics-based reading curriculum supplemented by Visual Phonics, can kindergarten and first-grade students who are deaf or hard of hearing demonstrate improvements in beginning reading skills as measured by standardized assessments of (a) word reading, (b) pseudoword decoding, and (c) reading comprehension?

It was hypothesized that the mean score at posttest would be greater than the mean score at pretest on all three test measures. The results of this study support the hypothesis stated for the research question. After receiving instruction from the Reading Mastery I curriculum supplemented by Visual Phonics, the mean score of each cohort of students was higher at posttest when compared to pretest measures. In addition, the results of a paired-sample *t* test revealed that the findings obtained on the Word Reading subtest were considered statistically significant and the effect size was large.

Because a convenience sampling procedure was used in this study and students received instruction from three different sections of the Reading Mastery I curriculum, we were able to further explore the students' performance on the WIAT-II (PC, 2002) relative to the type and amount of instruction received. This exploration revealed several interesting findings that further support the acquisition of skills from the Reading Mastery I curriculum were evident and related to students' performance on the standardized measures of reading achievement.

The four kindergarten students placed in Cohort 1 received instruction from Lessons 1–50 in the Reading Mastery I curriculum. During these 50 lessons, students are taught 12 sounds including three vowels (short /a/, long /e/, and short /i/), eight consonants (/m/, /s/, /r/, /d/, /f/, /t/, /n/, and /c/), and one consonant combination (voiced /th/). Knowledge of the letter–sound correspondences taught was apparent when we examined the students' responses to items on the Word Reading subtest of the WIAT-II (PC, 2002). It was clear from this examination that the students in Cohort 1 were able to correctly answer items related to skills taught in the curriculum. For example, all students in this cohort were able to correctly identify the letter–sound correspondence that included individual sounds they had been taught (i.e., /a/, /st/, and /dr/) but were unable to identify those that had not been directly taught (i.e., /w/, /g/, and /sh/).

To further support the relationship between skills taught in the Reading Mastery I curriculum and student performance on the WIAT-II (PC, 2002), we examined the responses of the first-grade students in Cohorts 2 and 3 on this same subtest. In Lessons 51–108, students in Cohort 2 were taught 12 additional sounds composed of four vowels (short /o/, long /a/, short /u/, and short /e/), seven consonants (/h/, /g/, /l/, /w/, /k/, /v/, and /p/), and one consonant combination (/sh/). Students in Cohort 3 received instruction from Lessons 112–148 and were exposed to 10 additional sounds including two vowels (long /i/ and /oo/ as in moon), four consonants (/b/, /y/, /x/, and /j/), one consonant combination (/ch/), and the -er and -ing endings.

Not surprisingly, in addition to the sounds correctly identified by the kindergarten students, students in these two cohorts were also able to correctly identify the letter–sound correspondences for the /w/, /g/, and /sh/ sounds because instruction on these sounds occurs in Lessons 51–108 in the Reading Mastery I curriculum. In addition, these students were able to correctly identify beginning and ending sounds and blend sounds to form words because these test items included sounds taught after Lesson 50.

In addition to the Word Reading subtest, the relationship between the curriculum and test measures

was also evident on the Pseudoword Decoding subtest. Students in Cohort 2 were able to correctly respond to pseudowords containing regular consonant–vowel–consonant patterns that contained sounds they had been taught in the curriculum such as *fum*, *pon*, and *vun*. In addition to these pseudowords, the students in Cohort 3 were able to correctly identify the pseudowords *bin*, *kip*, *leb*, *herp*, and *chag* because they had received instruction on additional sounds and sound combinations. However, none of the students were able to respond correctly to pseudowords containing sounds that had not been addressed in the first 148 lessons of the curriculum such as words containing the r-controlled vowels /ir/ and /ur/ as in *lurst* and *clurt* and those pseudowords following the silent-e rule such as *shafe* and *sote*.

In relation to the Reading Comprehension subtest, a discrepancy between the skills taught in the Reading Mastery I curriculum and those measured on the WIAT-II (PC, 2002) may explain the lack of measurable grade equivalent gains noted on this subtest for students in Cohorts 2 and 3. Although the majority of students were able to receive credit for correctly matching individual words or phrases to pictures and answering questions about sentences read, all students had difficulty answering the five comprehension questions related to a paragraph read. An analysis of this paragraph helps explain the difficulty the students experienced on this test item.

The Flesch–Kincaid readability statistic uses the number of words per sentence and number of syllables per word to calculate a grade level readability for a given passage. When this statistic was applied through a word-processing program to the 109-word passage included in the WIAT-II, a grade equivalent of 4.2 was obtained. The last passage in the Reading Mastery I curriculum read by students in Cohort 2 was included in Lesson 108. This story has 41 words and a Flesch–Kincaid readability of 0.0 due to the limited number of words and simplicity of the passage. The final story the students in Cohort 3 attempted was included in Lesson 148. Although this story was 120 words in length, the readability of this passage measured by the Flesch–Kincaid statistic is 1.1. Given the discrepancy between the passages in the curriculum and the one contained in the Reading Comprehension

subtest, it is not surprising that the students in Cohorts 2 and 3 would have difficulty reading and comprehending this passage because the readability was more than three grade levels above their current instructional level.

Social Validity

Several observations noted on the teacher log sheets reveal the social appropriateness of the intervention procedures utilized in this study and the generalization of skills acquired. For example, all three teachers reported that when students came across a previously taught word, they utilized the same procedure they have been taught in the Reading Mastery I curriculum to read the word; blending each sound slowly twice, saying the word the “fast way,” and then signing the word. The students were observed applying this procedure both during reading instructional sessions as well as other times throughout the day (e.g., language class or in the hallway). The teachers documented that they believe that the auditory and kinesthetic feedback acquired through this procedure prompted the student to remember the previously taught words. This same information was included in the observation summaries completed by the first author.

The teachers also indicated no difference in the students’ ability to use the aforementioned procedure based on degree of hearing loss or use of amplification. However, they did notice that the students with severe hearing losses or those who utilized amplification tend to provide a vocal sensation along with their responses more often than those students with profound hearing losses or those who do not utilize amplification. For this second group of students, mouth movements alone or those accompanied by the Visual Phonics cues were used when reading previously taught words. The first author also included these comments in her observational summaries.

Teachers also reported that many of the students use the reading procedure taught when encountering unknown words. They indicated on their log sheets that although the students were typically successful in applying the blending procedure, they sometimes had difficulty knowing the sign for the word. However, the teachers agreed that this situation provided an

opportunity to expand the students' sign language vocabulary and that students often remembered the meaning of the word relative to the print and Visual Phonics cues if several repetitions of the sign were provided.

Another example included in the teacher log sheets demonstrated the generalization of knowledge obtained through the curriculum. On a visit to the assistant principal's office to see a hermit crab, one of the students noticed a shelter in the crab's cage. Upon seeing it, the student turned to the teacher and provided the Visual Phonics cues and appropriate mouth movements for the sounds /h/ /u/ /t/. The teacher indicated that the word *hut* had been recently taught through the Reading Mastery I curriculum.

Limitations

We acknowledge several limitations to this research. First, since the Reading Mastery I curriculum was adopted by the school as the basal reading program for all students who are deaf or hard of hearing in kindergarten and first grade, there were no students available at the time of the study to serve as control group members. To alleviate this limitation, future studies should evaluate the effectiveness of the Reading Mastery I curriculum as compared to other reading curricula used with students who are deaf or hard of hearing.

Second, the small sample size ($N = 13$) makes it difficult to draw conclusions regarding the effect of degree of hearing loss beyond this study. Furthermore, the limited number of students ($n = 9$) who were administered the Pseudoword Decoding and Reading Comprehension subtests made it impossible to evaluate the results using a statistical test such as the t test. Additional inquiries of this type should be conducted with larger number of students to minimize these limitations.

Third, the standardization information included in the WIAT-II (PC, 2002) for the Reading Comprehension subtest was not sensitive enough to capture the gains made by students and included passages more than three grade levels above the students' current instructional level. To mitigate this limitation, future investigations should employ a standardized measure

of reading comprehension more closely aligned with the instructional level of the Reading Mastery I curriculum in order to obtain more accurate information regarding the gains acquired in the area of reading comprehension.

The difficulty in locating individuals qualified to assess deaf and hard-of-hearing students in both phonics production and in the use of Visual Phonics cues raises the question of potential bias in administering and scoring test measures. In this study, the first author was responsible for test administration and scoring, and 38% of the test sessions were observed by a participating teacher. Although we acknowledge this limitation, we also draw attention to the examples of alignment between the Reading Mastery I curriculum and students' performance on the standardized measures of reading achievement outlined in the Discussion section and the examples supporting the social validity of the intervention provided to minimize this concern. Whenever possible, future studies should involve data collectors and scorers blind to study conditions and individuals not directly involved in implementation of the curriculum.

Finally, the first author served as consultant for implementation of the reading program, closely observing and advising teachers over a several-year period. The likelihood that this level of involvement and mentoring would be available in other sites raises an issue of social validity. Future investigations evaluating the effects of amount and type of training provided to teachers as it relates to student performance could be conducted to address this issue.

Conclusion

The results of this study indicate that given 1 year of instruction from a phonics-based reading curriculum supplemented by Visual Phonics, kindergarten, and first-grade students who are deaf or hard of hearing can demonstrate improvements in beginning reading skills as measured by standardized assessments of (a) word reading, (b) pseudoword decoding, and (c) reading comprehension. The difference between the Word Reading scores obtained on the pretest and the posttest was statistically significant. Although a statistical test could not be applied to the participants'

performance on Pseudoword Decoding and Reading Comprehension due to limited available data, the sample descriptive statistics of the raw scores in the pretest and the posttest for these two dependent measures showed a similar pattern: participants outperformed in the posttest. Furthermore, when the raw scores were calculated into grade equivalent, our participants performed better than the national population average for students who are deaf or hard of hearing.

Interestingly, the acquisition of these beginning reading skills did not appear to be related to degree of hearing loss. In this study, students with various degrees of hearing loss benefited equally well from this phonics-based reading curriculum supplemented by Visual Phonics.

This finding is consistent with that reported by Trezek and Malmgren (2005) when a similar intervention was employed with middle school students who are deaf or hard of hearing. Future studies of this type should be conducted with larger number of students with varying degrees of hearing loss and grade placements to further explore whether the acquisition of phonemic awareness and phonic skills leads to improvements in other areas of reading such as fluency, vocabulary, and comprehension for readers who are deaf or hard of hearing.

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