

# **An evaluation of an intervention using sign language and multi-sensory coding to support word learning and reading comprehension of deaf signing children**

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## **Abstract**

The reading skills of many deaf children lag several years behind those of hearing children, and there is a need for identifying reading difficulties and implementing effective reading support strategies in this population. This study embraces a balanced reading approach, and investigates the efficacy of applying multi-sensory coding strategies and reading scaffolding to facilitate elementary phase deaf readers' reading development. Sign language – in combination with multiple visual, tactile and kinaesthetic coding strategies and reading scaffolding techniques – was used to facilitate literacy and vocabulary development. Participants were 64 children, diagnosed with severe to profound bilateral hearing loss and aged from 6;03 to 11;08 years (mean age 9.37 years). Participants were randomly assigned to an experimental and a control group. There were no significant differences between the groups pre-intervention on measures of sight word fluency, word recognition, receptive and expressive vocabulary knowledge and reading comprehension. Results demonstrated a significant increase in reading and vocabulary skills of deaf readers who received the balanced reading approach intervention, as compared to the control group who received usual classroom instruction. The article concludes with a discussion of the theoretical and pedagogical implications these findings have for deaf children's reading and literacy development.

## **Keywords**

Balanced reading approach, deaf signing children, multi-sensory coding, reading development, sign language

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## I Introduction

The literature reveals that deaf and hard-of-hearing (D/HH) children usually have deficits in literacy development compared to hearing children (Kyle and Harris, 2010, 2011). From the early school years through university, D/HH students typically lag behind their hearing peers in reading achievement, regardless of the degree of their hearing loss and whether or not they have had cochlear implants (Archbold et al., 2008; Marschark et al., 2012; Moeller et al., 2007). The major impediment to deaf children's reading development is not simply an inability to speak English but rather insufficient language development (whether signed or spoken) directly related to the language disparity that exists because the majority of deaf children have hearing parents (see Hermans et al., 2008; Reitsma, 2009; Rinaldi and Caselli, 2009; Yoshinaga-Itano, 2004).

A further complication is a discrepancy between deaf children's incomplete spoken language system and the demands of reading a speech-based system (Geers and Hayes, 2011). This makes it very difficult for them to become fluent readers because it is assumed that they possess many of the skills onto which reading is usually mapped but which they in fact lack, or which may be underdeveloped; for example, phonological, syntactic, semantic and discourse skills (Geers and Hayes, 2011).

In reviewing the literature on deaf education, research suggests a shortage of evidence-based teaching practices (empirical evidence) to enhance deaf children's literacy skills in general (Luckner and Handley, 2008). According to Cannon et al. (2011), teachers have struggled for generations to determine effective strategies for teaching English language skills to D/HH students and to recognize their relationship to reading success. This concern is even greater within the South African education context because teachers in schools for the deaf are not required to have any formal training or qualification in deaf education, resulting in many hearing teachers having little or no knowledge of the pedagogical implications of teaching literacy to children who are deaf, whether by means of oralism or sign language instruction (Storbeck, 2005).

Epistemologically there are two paradigms for acquiring knowledge, namely the 'transmissional', which is rooted in positivism, and the 'transformative', which states that children construct meaning through their interpretive interactions in their social environments, i.e. social constructivism (Attarzadeh, 2011). Social constructivism is often said to derive from the work of Vygotsky (1978), whose theory followed the principle of Zone of Proximal Development (ZPD). The ZPD represents skills, ideas and understandings, just beyond the child's reach, that the child can achieve with the support and scaffolding of adults and more skilled peers (Justice and Ezell, 2004). From a social constructivist perspective, this study will apply the principles of social constructivism to investigate whether signing deaf elementary phase readers (Foundation Phase in South Africa) under the guidance of teachers can benefit from interactive activities and progress from lower to higher levels of thinking. Acknowledging the prior knowledge that deaf readers bring to the classroom, together with individual reader's skills and competencies, it is an attempt to shed light on ways of improving signing deaf readers' reading comprehension by utilizing reading scaffolding techniques that function by:

- expanding deaf children's vocabulary knowledge through interactive 'word wall' exercises, using sign and multi-sensory, coding techniques;
- increasing their sight word vocabulary (word automaticity) through the application of sign/print mapping (i.e. techniques such as 'sandwiching' and 'chaining') and fluency games such as 'snap'; and
- guiding deaf readers to apply cognitive and metacognitive reading comprehension strategies (i.e. questioning, predicting, visualization and summarizing: retelling/signing of stories).

Research findings confirm the interactive nature of reading, acknowledging the involvement of both lower- and higher-order reading skills in reading development (Pressley, 2006). The present article will discuss research findings involving the following skills considered essential to deaf readers, namely phonological awareness, word identification, vocabulary, and the application of cognitive and metacognitive reading comprehension strategies.

### *1 Phonological awareness*

Phonological awareness (or coding) refers to the orthographic–sound correspondence of written language and the application of this knowledge when reading or writing (Mayberry et al., 2011). Research on the phonological awareness of deaf readers has been broadly concerned with determining how they cognitively code printed words (Schirmer and McGough, 2005). A recent meta-analysis conducted by Mayberry et al. (2011), investigating the relation of phonological awareness to reading achievement in deaf readers, revealed conflicting results. For example, studies of deaf students who sign or speak have found evidence that they use phonological skills in reading (Colin et al., 2007; Kyle and Harris, 2010), whereas other studies of deaf students (both those who sign and those who speak) have not found any evidence of phonological coding (Kyle and Harris, 2006).

Alternatively, other researchers have explored and reported on the application of manual and visual coding strategies that can be used successfully by deaf readers for representing English phonemes, morphemes and words (Haptonstall-Nykaza and Schick, 2007; Padden, 2006; Reitsma, 2009). In order to facilitate their recall of letters or words, deaf children can rely on finger spelling, which involves using the letters of the manual alphabet to rehearse individual letters or to spell out whole words (Reitsma, 2009). In addition, researchers have explored the use of cued speech or visual phonics as a means of developing the phonologically related skills of individuals who are deaf or hard-of-hearing (Narr, 2008; Smith and Wang, 2010). Although limited, existing findings are promising, having demonstrated that visual phonics in combination with a phonics-based curriculum significantly increases phonological awareness and speech production in D/HH students (Smith and Wang, 2010).

### *2 Word identification*

Novice readers first have to learn to recognize the ‘building blocks’ of a sentence efficiently in order to achieve reading comprehension; that is, they must be familiar with the words and their functions in a sentence (Miller, 2005). Although some researchers believe that differences in the identification of printed words do not explain the low reading comprehension scores among deaf readers (see Wauters et al., 2006), other researchers (see Berends and Reitsma, 2006) argue that higher word reading skills leave more cognitive resources available for the ultimate purpose of reading, which is comprehension of the text.

The rationale behind the reading delays of deaf readers is often referred to as the ‘phonological deficit hypothesis’, that is their restricted or limited access to spoken language and concomitant inability to link graphemic information with corresponding phonemic information prevents them from excelling in activities aimed at learning words and reading comprehension (Wauters et al., 2006). In contrast, other researchers (see Haptonstall-Nykaza and Schick, 2007) argue that deaf children have a natural propensity to use visually based, orthographic word-processing strategies and can develop efficient tactics for learning new words through direct instruction, scaffolding, and multiple exposure to words in a variety of reading contexts. Although little is known about the

exact nature of how deaf students use mental representations of sign language to decode words/text, it has been put forward that sign coding provides semantic links with words; that words accompanied by a graphic representations, for example, pictures and objects, were recognized better than words that were not; and that deaf readers' word identification abilities are correlated with the signability of written words (recall tasks) (see Schirmer and McGough, 2005).

### 3 *Vocabulary knowledge*

Vocabulary knowledge refers to word meanings readers acquire through exposure and formal instruction to store in long-term memory (Geers and Hayes, 2011: 50). From the literature it is evident that hearing loss affects children's vocabulary development, particularly that of deaf children with hearing parents, that is D/HH children tend to have smaller lexicons, slower rates of new word acquisition, and a narrower range of contexts that foster word learning (Prezbindowski and Lederberg, 2003). Researchers (see Marschark et al., 2009) assert that deaf readers' delays in acquiring or learning new vocabulary are likely to impede higher-level reading processes in two ways: first, by slowing down or disrupting the determination of the meaning of a word; and, second, by placing a heavy load on their available cognitive resources.

### 4 *Reading comprehension*

Researchers highlight two basic characteristics of good readers, namely, that they should be 'purposeful' and 'active' (Banner and Wang, 2011; Schirmer and McGough, 2005). In practice, this implies that good readers activate prior knowledge; constantly evaluate whether their reading goals are being met; frequently formulate predictions and make inferences; and read selectively (National Reading Panel, 2000). Such skills are acquired incidentally by many hearing children but for deaf children it appears that they need to be taught more deliberately (Borgna et al., 2011). Specifically, it has been demonstrated that D/HH children struggle more than their hearing peers to utilize prior knowledge to acquire new information (see Hauser et al., 2008); they are less accurate than hearing peers in knowing what they know (see Marschark et al., 2012); and most are unable to predict their performance accurately. Given the limited number of empirical studies carried out on deaf readers, Schirmer and McGough (2005) could not draw definite conclusions about the most effective strategies to elicit prior knowledge, but they did conclude that 'providing extensive information before reading is considerably more valuable than providing brief information' (p.99). Thus, it is imperative that teachers and caregivers acquire adequate passage-specific and topic-specific knowledge and explicitly engage deaf students in elaborative, meaningful and creative discussions about reading topics before assigning them reading tasks (Paul, 2003).

With regard to deaf children's abilities to apply reading comprehension strategies, evidence exists that some deaf readers are able to apply the same and equally effective cognitive and meta-cognitive strategies as can hearing readers (Schirmer, 2003). In contrast, other researchers (see Banner and Wang, 2011; Moores and Martin, 2006) have argued that many deaf readers do not automatically apply comprehension strategies because they continue to struggle with lower text-based skills, such as word recognition and vocabulary.

In the present study, a balanced reading approach was selected to enhance the reading comprehension of deaf readers. In practice, this implied addressing deaf readers' challenges with regard to word identification and vocabulary knowledge by exposing them to multi-sensory word-coding activities, whilst concomitantly using their sign language skills to establish an interactive reading environment, and guiding them, through scaffolding, to apply the comprehension strategies

mentioned above. The study aims to identify whether this balanced reading intervention has a beneficial effect on deaf children's reading and vocabulary skills and knowledge.

## **II Method**

### *1 Design*

This study employed experimental a pre-test post-test research design. The researcher investigated whether multi-sensory coding and scaffolding of reading comprehension strategies can improve the reading performances of deaf elementary phase children.

### *2 Participants*

Participants were selected from a convenience sample of children in the elementary phase at a residential school for the deaf located in a rural area in the Free State Province, South Africa. The school has a bilingual sign policy, meaning that South African Sign Language (SASL) is introduced as the first language of deaf children and English (primarily in its written form) is introduced as their second language. The development of SASL is encouraged by the employment of hearing staff proficient in SASL together with the appointment of deaf native users of sign language as classroom assistants.

Deaf children with reading problems in the elementary phase who tested two or more years behind their grade level (in reading) were the target population for this study. In total, 64 children (40 boys and 24 girls) participated in this study. Their ages ranged from 6 years and 3 months to 11 years and 8 months (mean age 9.37 years). The deaf children had been diagnosed with severe to profound bilateral hearing loss (>90 dB in the better ear) and came from hearing families of low socio-economic status. The area where the study was conducted is described as being a low socio-economic area, with informal housing, in which parents receive grants from the government. There is a feeding scheme at the school which is state subsidized. The consent of both the parents and guardians and permission of the Free State Department of Education was sought in writing before recruiting the participants to the study. The participants were randomly assigned to either the experimental or control group.

### *3 Measuring instruments*

The following standardized and diagnostic tests were administered:

- the Raven's Colored Progressive Matrices (to assess non-verbal intelligence quotients) (Van Rooyen, 2002);
- ESSI reading tests (standardized instrument to assess word recognition) (Esterhuysen, 1997);
- diagnostic instrument evaluating the children's sight words;
- diagnostic instrument evaluating the children's level of receptive and expressive vocabulary knowledge (separate tests for Grades 1, 2 and 3); and
- diagnostic reading comprehension test, for each grade separately (i.e. Grades 1, 2 and 3).

In total, five tests were administered prior to and after the intervention period of 9 months. The tests include two standardized measures, namely the Raven's Progressive Matrices (Van Rooyen, 2002), and the ESSI word recognition tests (Esterhuysen, 1997). Both of these were standardized for

South African norms and were thus deemed appropriate for the present investigation. Reliability coefficients of both these tests are high; for example, for the Raven's it is .90 and for the ESSI reading tests .816, which implies a high degree of internal consistency (Esterhuysen, 1997). In addition to the two standardized measures, the author developed three diagnostic tests that measured deaf readers' sight words, vocabulary knowledge and reading comprehension. The researcher opted to utilize equivalent/alternate-forms reliability measures to determine the reliability coefficients for the diagnostic tests. Two test forms ('Form A' and 'Form B') were developed for each of the diagnostic tests and were administered to the 64 participants in this study (one week time interval). To eliminate any test anxiety that could potentially affect the participants' scores, each test was explained and demonstrated first, followed by the administration of two sample items. The participants' scores on Form A of the diagnostic tests for sight words, vocabulary and reading comprehension were correlated with their respective scores on Form B of the diagnostic tests to calculate the alternate-forms reliability coefficients.

The diagnostic sight word tests were developed from high-frequency word lists, i.e. the Dolch list (Dolch, 1948), as well as the first/second hundred wordlists for elementary phase readers of Vaughn et al. (2007). From these lists, a pool of 40 sight words with sign equivalents (in SASL) were selected for Form A and Form B (20 items per test). The alternate-forms reliability coefficient for the sight word measure was .85 ( $p < .0001$ ). The list of sight words, presented on an A4 page (font size: 36), were administered individually to deaf readers. The children looked at the printed form of the word and produced the sign equivalent of each word via SASL. The maximum mark that could be obtained for the diagnostic sight word measure was 20.

The diagnostic tests for vocabulary knowledge and reading comprehension included words/content from the different stage readers of the Oxford Reading Tree Series (Brychta and Hunt, 2011), for example Stage 1, Stage 2 and Stage 3 (Brychta and Hunt, 2011), including authentic words from the storybooks to which they had access in the various classrooms on a daily basis. The diagnostic vocabulary test was assessed individually. In developing this test the researcher consulted the Peabody Picture Vocabulary Test, 4th edition (PPVT-4; Dunn and Dunn, 2007). Similar procedures were followed in determining the reliability of the vocabulary test (i.e. calculating alternate-forms reliability coefficients after administering two equivalent forms of the vocabulary test). The alternate-forms reliability coefficients of the vocabulary measure for all three grade groups were above .80 (Grade 1 = .81; Grade 2 = .84; Grade 3 = .83). The diagnostic vocabulary measure consisted of two tasks, the first of which focused on the child's receptive vocabulary skills. During administration the child observed a sign (signed by one of the examiners) and four pictures and had to match the sign with the corresponding picture (10 test items). The second task was a production task. During this task the child looked at a picture and had to produce the corresponding SASL sign (ten test items). The maximum mark that could be obtained for the diagnostic vocabulary test was 20.

From the Oxford Reading Tree Series (Brychta and Hunt, 2011), the researcher selected two reading passages from each Stage series (Stage 1, Stage 2 and Stage 3) and developed similar reading comprehension tests based on these series stories, separately for each grade (i.e. 'Passage A' and 'Passage B'). The maximum score that could be obtained for the reading comprehension test was 10 marks. After the reading passage had been read, the 10 questions based on the story were signed by the examiner and the child responded via signing. The alternate-forms reliability coefficients of the reading comprehension test for Grades 1, 2 and 3 were .85, .86 and .84 respectively.

All tests were administered individually via SASL under the supervision of the author by three fluent D/HH signers (adults), two of whom were native SASL signers; and one a hard-of-hearing teacher who was a fluent signer. All examiners were uniformly trained in the administration and

scoring of these tests. All scores were then calculated and verified by an independent moderator (i.e. a psychologist working at the local school clinic). All tests that were administered complied with reliability and validity criteria (i.e. alternate-forms reliability coefficients for sight words, vocabulary and reading comprehension exceeded 0.80). With regard to content validity, the advice and expertise of qualified departmental officials and peers at other tertiary institutions were sought in selecting test items for the three diagnostic tests for sight words, vocabulary knowledge and reading comprehension.

#### 4 Reading intervention

*a Experimental group.* Prior to the commencement of the intervention period, the author, with the assistance of an occupational therapist at the sample school, and in close collaboration with the three relevant classroom teachers, developed individual reading workbooks for each grade group. For example, six reading workbooks were developed for each stage's reading series, namely Stage 1, Stage 2 and Stage 3. Deaf children in the experimental group received small group instruction (two to three children) for three days per week, for 45 minute sessions, for 9 months. The teachers incorporated multiple strategies, which entailed the following:

First, three to five target words (vocabulary words) from the Oxford Reading Tree Series were selected and reinforced daily (through interactive 'word wall' activities). After the children had pasted a word on the 'word wall', its meaning was reinforced by matching the printed form of a word with an object, picture, action or corresponding SASL sign and finger spelling the word. This 'print-language mapping' uses techniques known as 'sandwiching' and 'chaining'. The definition of the word and its synonyms were provided via SASL and the words were used in sentences. Further reinforcement activities included having children trace words on sandpaper, complete exercises in their reading workbooks, make clay models of the words and their meanings (three-dimensional symbols), and sort vocabulary cards of word meanings into different categories or themes (e.g. transport, fruit, vegetables and animals). Next, the teachers reinforced sight words by sign, print, and picture mapping exercises (i.e. one or two words per day, for the first three days of the week). On days four and five, automatic recall of sight words (i.e. word fluency) was further enhanced by using flashcards and by playing fast word-recognition games, such as 'snap', i.e. picture, word and/or sign matching games. Regular passage or story-book reading was introduced daily. While the teacher was signing the story, the classroom assistant demonstrated the A3 pictures displayed in the bigger version of the book and turned the pages. During these reciprocal reading experiences the teacher actively involved the children by guiding them (scaffolding) in the use of reading comprehension strategies such as predicting, questioning, visualizing (mental imagery) and summarizing or retelling stories in SASL.

*b Control group.* Over the 9-month period, deaf children in the control group received classroom instruction according to the curriculum guidelines contained in the Elementary Phase Literacy Curriculum of the Department of Education (National Department of Education, 2002). Although both groups had access to the same reading series (i.e. Oxford Reading Tree series), the difference was that children in the control group followed a whole language approach, embedded in bilingualism only. In practice, this implied that they were neither explicitly guided to make use of multi-sensory coding nor taught the principles of print-language mapping. They were not guided in the application of reading comprehension strategies (i.e. scaffolding), such as questioning, predicting, summarizing and visualization; and they did not have access to the reading workbooks developed for this intervention study.

### III Results

A pre-test post-test group design was utilized to compare the efficacy of the intervention study with regard to sight words, word recognition, vocabulary knowledge and reading comprehension. Table 1 shows the scores obtained for each group across the reading and language measures pre- and post- intervention. Prior to the intervention, *t*-tests were conducted to determine whether the two groups were matched. The results revealed no significant differences between the groups before the intervention for chronological age ( $t = 0.31, df = 62, p = .75$ ), non-verbal intellectual abilities ( $t = .07, df = 62, p = .94$ ), diagnostic sight word reading ( $t = .27, df = 62, p = .78$ ), ESSI word recognition ( $t = .81, df = 62, p = .41$ ), receptive and expressive vocabulary ( $t = .003, df = 62, p = 1.00$ ), and reading comprehension scores ( $t = .45, df = 62, p = .64$ ). Furthermore, deaf children in both the experimental and control groups had difficulty in recognizing words from the reading series books, and they had noteworthy deficits in vocabulary knowledge and reading comprehension.

After the period of reading intervention (9 months), *t*-test analyses revealed significant differences in the post-intervention mean scores between the experimental and control groups: sight word reading ( $t = 32.53, df = 62; p < .0001$ ); word recognition (ESSI) ( $t = 28.17, df = 62; p < .0001$ ); receptive and expressive vocabulary knowledge ( $t = 20.58, df = 62; p < .0001$ ); and reading comprehension ( $t = 16.49, df = 62; p < .0001$ ).

Figure 1 shows the mean scores across the measures for the two groups at the post-intervention stage. Prior to the intervention, both the experimental and control groups fared poorly on the tasks, with the majority of deaf readers' percentage correct responses for pre-tests varying between 1.2% and 2.35% with regard to all variables included in this investigation (see Table 1). By the end of the intervention period of 9 months, the children in the experimental group demonstrated a considerable improvement in diagnostic sight word reading, ESSI word recognition, vocabulary knowledge and reading comprehension as compared to their pre-intervention scores and as compared to the control group (see Table 1 and Figure 1). The percentage correct responses of children in the experimental group improved to 69.8 % for sight words, 67.5% for word recognition, 78% for vocabulary knowledge, and 79% for reading comprehension. Further individual analyses of the performances of members in the experimental group reveals noteworthy contributions; whilst only a third or fewer of the deaf readers in the experimental group performed above the mean for all participants in the four reading domains prior to the intervention (sight words: 25%; word identification: 31%; vocabulary: 34%; and reading comprehension: 6.2%), the majority of deaf readers in the experimental group performed above the mean for all participants for these four reading domains after the intervention. For example, post-intervention scores showed that with regard to word reading, deaf children in the experimental group scored above the participants' mean for both sight words and word recognition (i.e. 63% scored above the mean sight word score, whilst 68.7% scored higher than calculated mean for the standardized word recognition measure); for vocabulary, 62.5% performed above the calculated mean, and 75% performed above the mean for reading comprehension. According to these calculations the vast majority of deaf readers in the experimental group (i.e. better and weaker readers) benefitted greatly from utilizing multiple interventional strategies. This significant findings were further supported by large effect sizes (see Cohen, 1987) being calculated for sight words (.94), word recognition (.92), vocabulary (.87) and reading comprehension (.81).

### IV Discussion

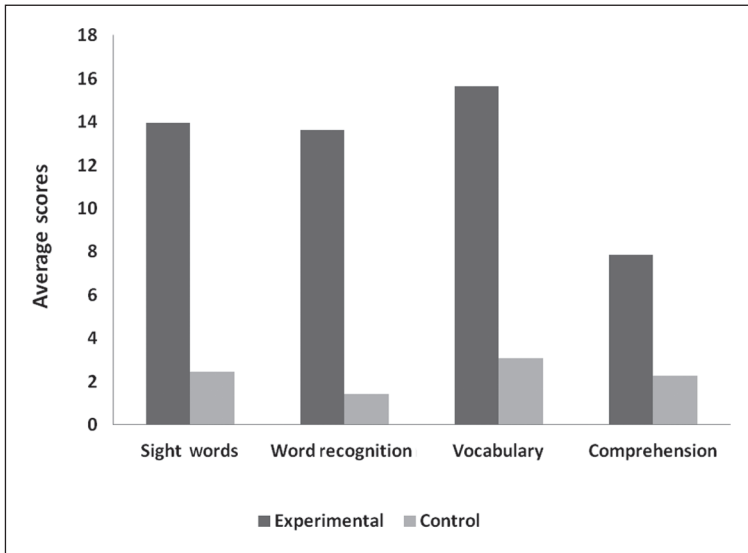
From a social-constructivist viewpoint, the author's point of departure was, first, to strengthen deaf readers' SASL skills and, second, to utilize their signing skills to develop English literacy skills that focused on improving their fluency in sight words and their ability to recognize and decode



**Table 1.** Mean scores () for the experimental and control groups for age, non-verbal IQ, sight words, word recognition, vocabulary and comprehension for pre- and post-test scores (standard deviations in parentheses).

Group	Age in years	Non-verbal IQ	Diagnostic sight words (n = 20)		ESSI word recognition (n = 20)		Vocabulary (n = 20)		Reading comprehension (n = 10)	
			Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Experimental (n = 32)	9.38 (1.7)	11.09 (3.4)	0.25 (0.45)	13.96 (2.08)**	0.34 (0.48)	13.53 (2.3)**	0.47 (0.76)	15.63 (3.02)**	0.19 (0.59)	7.88 (1.33)**
Control (n = 32)	9.36 (1.6)	11.07 (3.3)	0.28 (2.4)	2.3 (0.99)	0.47 (0.50)	1.41 (0.79)	0.47 (0.71)	3.06 (1.66)	0.13 (0.49)	2.25 (1.74)

Note. \*\* p = .001.



**Figure 1.** Mean post-test scores: Diagnostic sight words, ESSI word recognition, vocabulary and reading comprehension (for both the experimental and control groups).

words, expand their vocabulary, and improve their reading comprehension abilities, by drawing on a combination of multi-sensory instructional strategies and effective scaffolding. The results show that following a 9-month intervention of balanced reading instructional techniques, profoundly deaf signing elementary-phase children had demonstrated a significant improvement in reading when compared to a control group who received the usual classroom instruction.

Compared to children in the experimental group, deaf readers in the control group improved only marginally with regard to sight word reading, word recognition, vocabulary knowledge and reading comprehension. All the deaf children in this study were exposed to the same reading material, the difference being the pedagogy informing the kind of reading intervention strategies implemented for the experimental group during the 9 months. The findings demonstrate that the benefits of following a whole language approach embedded in bilingualism only were marginal for the control group. A further explanation for this slight improvement in the control group is natural progression that might be expected over a period of 9 months.

The application of a combination of reading strategies appears to have been beneficial in the following ways. First, by creating interactive ‘word wall’ activities and applying specific strategies, such as teaching sign–print mapping, sign coding and finger spelling, also known as ‘sandwiching’ or ‘chaining’, the children’s knowledge of word meanings improved. These techniques were further complemented by the introduction of multiple visual, tactile and kinaesthetic activities, either concretely or semi-concretely, through activities in the reading workbooks. Second, the study aimed to increase deaf readers’ ability to recognize words more fluently and thus enhance their ability to decode words more efficiently. Two measures were administered to determine participants’ word reading abilities, a diagnostic sight word test and a standardized test to measure recognition of words (ESSI). Compared to participants in the control group, the experimental group improved significantly on both these measures. Thus, results from the present study confirm those of previous studies (see Wauters et al., 2006), which also demonstrated that deaf students

could develop effective word-learning strategies by applying multi-sensory coding strategies despite their apparently limited phonological decoding skills. It also supports researchers who have hypothesized that the iconic nature of sign language supports reading development in both deaf and hearing children by creating a bridge between the physical experience of the word and the abstract picture created by letters on the page (Haptonstall-Nykaza and Schick, 2007; Padden, 2006; Reitsma, 2009).

The social construction of knowledge in selecting multiple strategies to improve elementary phase deaf readers' reading skills included a combination of direct instruction strategies and scaffolding to apply multi-sensory coding and reading comprehension strategies. Close observation of deaf readers in the experimental group showed that they, first, draw on their 'strengthened' sign language skills to apply the principles of 'print-language mapping'. By scaffolding other coding techniques, such as visual, tactile and kinaesthetic, they were then systematically guided to decode words. This would appear to have contributed to more fluent word identification, vocabulary knowledge and reading comprehension. These results strengthen the case made by other researchers (see De Garcia, 2003; Padden, 2006; Reitsma, 2009) that merely knowing a sign language does not support the development of English literacy, but that tying specific elements of it to English print supports reading and writing in deaf signing individuals.

The literature suggests that some deaf readers (i.e. older students) apply cognitive and metacognitive reading strategies (Banner and Wang, 2011). However, the majority of studies have demonstrated that the reading comprehension skills of deaf children are relatively low and that most children have limited metacognitive skills (Borgna et al., 2011). The present study has demonstrated that younger deaf readers may benefit from cognitive and metacognitive reading strategies. Through reciprocal teaching procedures and reading scaffolding, younger deaf readers in the experimental group were explicitly guided by means of scaffolding to apply higher-order comprehension strategies such as predicting, visualization and summarizing. Post-test results have revealed significant gains in reading comprehension scores for deaf readers in the experimental group. The results of the present study have highlighted the need for further research in the area of deaf readers' abilities to apply cognitive and metacognitive reading comprehension strategies. Thus, the researcher concurs with others (see Banner and Wang, 2011; Schirmer and McGough, 2005) on the importance of encouraging teachers to provide deaf children with more opportunities to learn and apply advanced cognitive reading strategies during reading tasks.

With regard to the present study, the sample size is relatively small and so it is not possible to generalize these findings to the broader population of deaf readers. However, the study did make use of random assignment of participants to experimental and control groups, and it makes a valuable contribution given the paucity of available intervention research into the reading problems of D/HH children in South Africa. Following successful completion of the intervention study, the literacy curriculum of the elementary phase has been revised and all teachers were trained in the application of the balanced reading instructional techniques employed during the intervention. Future research is needed to determine if the results and findings of this study can be replicated and to investigate the maintenance of the intervention gains for deaf readers who are exposed to similar intervention strategies.

## **V Conclusions**

The findings of the present study offer several theoretical and pedagogical implications for the reading development of deaf children. First, from a social constructivist viewpoint the study has demonstrated the strategic role of the teacher, as facilitator in creating meaningful learning

contexts for deaf children to construct knowledge. Second, if literacy, and specifically reading, pedagogy is informed by the broader notion of constructivism, it should acknowledge individual differences in children's preparedness for literacy and reading achievement, and must reflect a definite understanding of the processes involved in learning to read and write. In doing so it should move away from an 'either/or' approach in trying to uphold the fallacious notion that there is only one single 'best' method to teach signing deaf children to read and write (Mayer and Akamatsu, 1999; National Reading Panel, 2000).

Practically, this study has highlighted once more the importance of creating a balanced literacy environment for signing deaf children to develop their reading and writing skills. The findings have also lent support to the use of a bilingual approach for deaf signing children that is embedded within a balanced literacy environment. Therefore, it is a pedagogy that is informed by both psycholinguistic and behaviouristic theories on reading development and that draws on multiple strategies and pathways to develop reading and writing in deaf children.

### Acknowledgements

The author would like to express her gratitude to all the deaf children and teachers for their valued participation in this study. Second, I would like to acknowledge Dr Andrew Graham for his contribution in editing this article, as well as the editors of CLT and the anonymous reviewers for their guidance in improving this manuscript.

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