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English Literacy Outcomes in Sign Bilingual Programs: Current State of the Knowledge

CONNIE MAYER AND BEVERLY J. TREZEK

The authors (a) examine the available peer-reviewed research documenting the literacy achievement of deaf children educated in sign bilingual programs, (b) identify gaps in the empirical literature, and (c) propose directions for future research. This review was limited to studies that reported reading and writing outcomes. On this basis, only 3 studies were identified, representing those published over a period of approximately 20 years (1997–2017) and collectively reporting literacy outcomes for 127 deaf students. Overall, the studies indicate that the majority of participants were not achieving reading comprehension scores in the average range; further, a wide range of variability in achievement was reported across the 3 studies. Factors potentially affecting achievement, such as the presence of additional disabilities, level of American Sign Language proficiency, use of hearing technologies, and parental hearing status, are also discussed.

KEYWORDS: deafness, literacy, bilingualism, literature review

The literacy achievement of deaf students has been an ongoing concern in the field since Pintner and Paterson (1916) reported that “very few deaf children (6.4 percent) reach scores above fourth grade ability” (p. 436). This is an observation that has held stubbornly true, despite the research and pedagogical attention that has been paid to this issue (e.g., curricular interventions, shifts in communication approaches) (see Allen, 1986; Conrad, 1979; Traxler, 2000; see also Qi & Mitchell, 2012, for a review). However, in the present educational climate, in which there is an increased emphasis on evidence-based practices leading to improved outcomes, it would be timely to take stock of the current state of the knowledge as it pertains to literacy

achievement for deaf students. One area in which there has not been such a systematic overview is the reading and writing performance of deaf students who have been educated in sign bilingual settings.

Sign bilingual programs have been an aspect of the educational landscape since the establishment of the first classes in Sweden in the early 1980s (Svartholm, 2007), with implementation being realized internationally over the following two decades (in, e.g., the United States, Canada, Australia, New Zealand, the Netherlands, and South Africa). These programs represented a move from monolingual education (e.g., English only) to a bilingual model, in which a natural signed language (e.g., American Sign Language [ASL])

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would be seen as the first language (L1) of deaf students and serve as the primary language of instruction. The underlying ethos of these programs includes the empowerment of Deaf people and the valuing of the culture and language of the Deaf community (Swanwick & Gregory, 2007). More specifically, from the perspective of the classroom, the aim was to provide education via a fully accessible natural language (e.g., ASL) that would allow for age-appropriate language and cognitive development and, in turn, the necessary foundation for learning to read and write.

One of the anticipated educational outcomes of the implementation of sign bilingual education was improved achievement in reading and writing, with suggestions of attainments approaching that of hearing-age peers (Wilbur, 2000). This claim was based on a model of linguistic interdependence (Cummins 1989, 1991, 2000) in which it is proposed that there is a common underlying proficiency across all languages that allows for the transfer of cognitive-academic and literacy-related skills from L1 to the second language (L2). In applying this principle to practice, it was proposed that deaf children could develop the ability to read and write in L2 (e.g., English) if they had a fully developed L1 (e.g., ASL) to allow for the transfer of skills, and were provided with the opportunity to engage in text-based activities in the L2 (Johnson, Lidell, & Erting, 1989; Lane, Hoffmeister, & Bahan, 1996; Small & Mason, 2008; Strong, 1988). Developing proficiency in a face-to-face form of the L2 (i.e., spoken and/or signed) was not seen as necessary for the development of L2 literacy.

From the outset, questions were raised about the applicability of the linguistic interdependence model in the context of deaf education, in which L1 and L2 do not share the same modality (i.e., L1 is signed, L2 is spoken) and L1 does not have a written

form. There were also questions as to whether it would be possible to bypass the acquisition of competence in a face-to-face form of the L2 and still develop L2 literacy (Mayer & Wells, 1996). As Paul, Bernhardt, and Gramly (1992) suggested,

There is no compelling evidence that first- or second-language learners achieve high levels of literacy through exposure to and instruction in the written form only of the target language. Thus, in addition to a working knowledge of ASL, deaf students need to achieve a level of competence in a primary form (e.g., speaking, signing, fingerspelling) of English that permits them, for example, to access printed words at a rapid automatic pace. (p. 89)

In the early years of sign bilingual education, these concerns were based primarily on theoretical arguments, as there was no research evidence base to inform the discussion. While there was already a robust body of empirical literature to support the efficacy of bilingual education for hearing children, there were enough differences between the contexts for hearing and deaf L2 learners to raise questions about the extent to which these findings applied to deaf students. There was a need to build an evidence base by conducting investigations in the context of sign bilingual education, particularly to determine the extent to which improved and/or age-appropriate reading and writing outcomes were being realized (Mayer & Leigh, 2010).

At the present juncture in the field, more than 30 years since Sweden became the first country where sign bilingual programs were implemented, a review of the available research evidence is warranted in order to determine current levels of literacy achievement, and to understand whether early concerns were justified. To date, to the best of our knowledge, there has not

been such a systematic review. While there is a considerable body of literature describing models of sign bilingual education and its implementation (e.g., Livingston, 1997; Mashie, 1995; Visual Language and Visual Learning, 2012), there are few studies that clearly document outcomes in order to provide empirical evidence in support of practice.

To that end, the focus of the present inquiry is guided by five research questions:

1. What are the reading and writing outcomes of deaf students educated in sign bilingual programs?
2. To what extent are these students achieving at a level commensurate with that of hearing-age peers?
3. How are literacy outcomes being measured?
4. What are the variables impacting outcomes?
5. What gaps were identified in the current research that can be used to inform the design and execution of future studies?

METHOD

Search Process

To conduct a search of the literature, various combination of keywords (e.g., *sign bilingual, deaf, literacy; sign bilingual, deaf, reading; sign bilingual, deaf, writing; sign language, deaf, literacy*) were entered into a search of electronic databases, including Academic Search Complete, Education Research Complete, and ERIC, to identify relevant works published in English. In an effort to ensure an adequate level of methodological rigor and study quality, the results were limited to articles published in peer-reviewed journals. Given the assumption that the body of literature would be relatively small, the year the search was conducted

(i.e., 2018) was the only limitation imposed in terms of publication date.

The initial literature search resulted in the identification of approximately 75 peer-reviewed articles covering a wide range of topics. Those that were clearly not associated with literacy outcomes, such as articles on how to assess deaf defendants' fitness for trial (Davidson, Kovacevic, Cave, Hart, & Dark, 2015), or breast cancer education for the Deaf community (Hickey et al., 2013), were immediately eliminated. The reference sections of articles were also reviewed to identify manuscripts that may have been missed in the electronic database search. The abstract and methods section of the remaining articles were then reviewed to determine if the inclusion criteria were satisfied.

Inclusion Criteria

Using criteria similar to those of a recently published review of the literature on literacy outcomes of deaf students with cochlear implants (Mayer & Trezek, 2018), studies were considered for inclusion in the present review if they

1. were conducted in English
2. included outcome data on a measure of reading comprehension or written expression for a group of participants ($N \geq 10$) educated by means of a sign bilingual approach
3. reported data in a manner that allowed a specific level of attained skill to be determined (e.g., norm- or criterion-referenced scores, grade equivalents)
4. provided disaggregated data for students educated under a sign bilingual philosophy if other participants were included
5. were published through 2018

Therefore, articles summarizing studies conducted in a language other than English (e.g., Teruggi & Gutiérrez-Cáceres, 2015), as well as reviews of the literature (e.g., Mayer & Akamatsu, 1999; Swanwick, 2016), descriptions of instructional practices (e.g., Andrews & Rusher, 2010; Berke, 2013; Cannon & Guardino, 2012), case studies or small-group studies (e.g., Enns & Lafond, 2007; Evans, 2004), and investigations of specific curricular interventions (e.g., Lederberg, Miller, Easterbrooks, & Connor, 2014; Trezek & Hancock, 2013) were not included. Studies were also excluded if a specific level of achievement could not be ascertained due to the type of the assessment or method used to report outcomes (e.g., Wolbers, Bowers, Dostal, & Graham, 2014). A total of 16 studies met the initial criteria for review.

Further review of the 16 studies led to the exclusion of studies that did not (a) represent participants exclusively educated by means of a sign bilingual approach, (b) include a measure of reading comprehension and/or written expression, (c) report data in a manner that allowed a specific level of skill attainment to be determined, or (d) provide disaggregated data. Specifically, five studies were excluded because they did not represent participants educated exclusively by means of a sign bilingual approach. For example, the first study that was excluded (Moore & Sweet, 1990) focused primarily on comparing the performance of deaf students with deaf parents to that of deaf students with hearing parents who were educated in a residential school for the deaf using a Total Communication philosophy. Participants in the second study (Chamberlain & Mayberry, 2008) were reportedly drawn from a variety of educational programs, and approximately 45% of individuals in the third study (Freel et al., 2011) were

educated in a mainstream setting. The fourth study (Myers et al., 2010) included participants drawn from the same population as the third and focused on comparing achievement across ethnic groups. In the final study (Twitchell, Morford, & Hauser, 2015), the researchers examined the impact of socioeconomic status on literacy development among individuals recruited from universities, schools, and summer camps, although history of educational placements was not reported.

An additional two studies were excluded because the measures used did not allow for a specific level of skill attainment to be reported. For example, in a study conducted by Singleton, Morgan, Digello, Wiles, and Rivers (2004), written expression was measured by asking students to retell a story previously viewed on video. In a second study (Andrew, Hoshoooley, & Joannis, 2013), an English sentence comprehension task was developed to explore the relationship between sign language ability and comprehension of written-English sentences. While neither of these studies reported norm- or criterion-referenced scores, it was interesting to note that a measure of ASL was utilized in each investigation.

Issues associated with data reporting were noted in six additional studies, which led to their subsequent exclusion from the present review. In two investigations (Aura, Venville, & Marais, 2016; Strong & Prinz, 1997), the researchers reported a combined standard score or Z score across more than one standardized measure, thus making it challenging to determine a specific level of attainment on one or the other assessment. In the third study (Narr, 2008), reading levels were reported as an average of three curriculum-based measures, and in the fourth investigation (Padden & Ramsey, 1998), only correlations between a standardized

measure of reading achievement and other assessments (e.g., fingerspelling, an initial-ized sign task) were reported (i.e., reading outcomes were not provided).

The fifth study (Scott & Hoffmeister, 2018) was an investigation of the development of academic English through an examination of “student proficiency with a sub-skill of academic writing called super-ordinate precision, the taxonomical categorization of a term” (p. 173). Participants wrote definitions for three common nouns (*anger*, *winter*, and *bicycle*), an exercise that is a subtest of the Core Academic Language Skills Instrument, or CALS-I (Uccelli et al., 2014). However, as this measure is still in development, it is not possible to consider performance in relation to a set of standards. In the final study (Harris, Terlektsi, & Kyle, 2017), disaggregated data were not reported for the students who were educated in British Sign Language (BSL). The three remaining studies (DeLana, Gentry, & Andrews, 2007; C. M. Lange, Lane-Outlaw, W. E. Lange, & Sherman, 2013; Scott & Hoffmeister, 2017) were thoroughly reviewed with a particular focus on the reporting of outcomes and any factors that were related to performance. Table 1 provides a summary of information obtained from these three studies.

RESULTS

All three of the studies included in the present review reported outcomes in reading; however, none investigated writing achievement. All three investigations were conducted in the United States, and only one received even partial funding. Across the three studies there were 127 total participants, ranging from second graders through high school students. All researchers reported whether students had additional disabilities, and two studies reported on parental hearing status. Information

regarding levels of hearing loss was provided in all three studies, and the type of hearing technology (i.e., hearing aids, cochlear implants) was reported in two. None of the researchers provided information about the consistency of use and/or management of the hearing technology, nor the extent to which students were able to access language via audition. Interestingly, only one study included a measure of ASL proficiency.

In the first study, DeLana et al. (2007) conducted their investigation in a public school for the deaf that had followed the CAEBER (Center for ASL/English Bilingual Education and Research) model for 10 years (see Nover, Andrews, Baker, Everhart, & Bradford, 2002, for a report).¹ In a CAEBER model, the primary goal is to promote bilingualism, multilingualism, and respect for all languages through school-based language planning, with a particular emphasis on the development of historically marginalized signed languages such as ASL. Key strategies featured in this model are

1. the appropriate use of scientifically research-based language planning in educational settings
2. acquisition, development, and use of both ASL and English for academic purposes by students as well as their parents and educational staff
3. training for educational staff in the strategic use of ASL and English as languages of instruction in educational settings
4. understanding and appreciation of language and cultural diversity

The 25 participants in the study by DeLana et al. (2007) ranged in age from 8 to 17 years, and two were identified with learning disabilities. Those with severe cognitive disabilities, and those who were

Table 1. Summary of the Reviewed Studies

Authors/ date	N	Age or grade level	Additional disability	Setting	Measure of sign proficiency	Literacy measure	Findings	Other
DeLana, Gentry, & Andrews (2007)	25	8–17 yrs.	2 students with a learning disability	Public school, used CAEBER model for 10 years	N/A	SAT-9 Reading Comprehension subtest	24% ($n = 6$) read at grade level, 72% within 2 grade levels of placement.	Excluded students with severe cognitive disabilities
C. M. Lange, Lane-Outlaw, W. E. Lange, & Sherwood (2013)	61	Grades 2–9 at initial testing, drawn from database	42% of sample	Charter school, CAEBER model; students exposed at least 4 years	N/A	NWEA MAP reading subtest	41% average to above average range after 4 years	42% had an additional disability; 42% had at least one deaf parent.
Scott & Hoffmeister (2017)	41	Middle school ($n = 19$), high school ($n = 22$)	2 students with low vision	3 bilingual schools for the deaf	ASLAI	SAT-HI or NWEA MAP reading subtest	SAT-HI/White students $M = 627.33$ (approx. 4.4 GE); non-White students $M = 578.75$ (approx. 2.3 GE)	White students ($n = 21$), non-White students ($n = 19$); 5 participants with at least one deaf parent

Notes. CAEBER = Center for ASL/English Bilingual Education and Research. SAT-9 = Stanford Achievement Test–9th ed. NWEA MAP = Northwest Evaluation Association Measures of Academic Progress.

ASLAI = American Sign Language Assessment Instrument. SAT-HI = Stanford Achievement Test–Hearing Impaired. GE = grade equivalent.

^a Race/ethnicity was not identified for one participant.

not educated in an ASL/bilingual model in this public school setting, were excluded from the study. In this investigation, the researchers used existing data to report on reading outcomes. The measure that had been used to assess achievement at the school was the Reading Comprehension subtest of the Stanford Achievement Test (SAT-9; 9th ed., 1996).

Results indicated that in 2004, 24% ($n = 6$) of study participants were reading at grade level, with an additional 72% reportedly within 2 grades of their class placement. In the discussion, the authors report on variables that influenced achievement and could be seen as facilitating agents. While numerous factors (e.g., IQ, socioeconomic status, home language, parental signing skills, level of hearing loss) were considered, most were described as having a slight, nonsignificant impact. The two factors found to be statistically significant, and thus to be the most substantial facilitating agents, were increased years of ASL use and higher levels of parental involvement. Interestingly, no measure of ASL was included, and with respect to the use of hearing technologies, about half of the cohort reportedly used hearing aids ($n = 12$), and although 88% had a profound hearing loss, none of students used cochlear implants. Parental hearing status was not found to have a significant impact, and there was no information reported with respect to students with additional disabilities.

The setting for the second investigation (C. M. Lange et al., 2013) was a charter school that also used the CAEBER model as described above, and as in the previous study, the researchers used an existing database to report outcomes. The 61 participants were drawn from grades 2–9, and to be included, had to have been exposed to the CAEBER model for at least 4 years. At the time of initial testing, 80% of the students were in grades 2–4. Of the group, 42% had

an identified additional disability and 42% had at least one deaf parent. In this study, reading outcomes were measured with the NWEA Measures of Academic Progress [MAP] (Northwest Evaluation Association, 2019), the assessment that had been in use at the school since 1997.

In the summary of their findings, C.M. Lange et al. (2013) report that “41% of study group participants were in the average to above average range in reading after a minimum of four years of exposure to an ASL/bilingual model” (p. 541). Parental hearing status was not a significant factor influencing outcomes; however, students with additional disabilities were less likely to be in the average to above average group and evidenced slower academic growth overall. There was no reporting of the use of hearing technologies or level of ASL proficiency. In their conclusions, the authors emphasize that students exposed to an ASL/bilingual model make continual, albeit slower, progress, and that even though cause and effect was not the goal of the study, the findings raise possibilities that the ASL/bilingual approach has merit.

In the final study, Scott and Hoffmeister (2017) drew their 41 participants from three bilingual schools for the deaf. The cohort included 19 middle school and 22 high school students, of whom 21 were White and 19 were non-White. (Race/ethnicity was not reported for one participant.) Five participants had deaf parents and two were identified as having low vision. The aim of this study was not primarily to report reading outcomes, but to explore “the potential relationships between reading comprehension, ASL knowledge and/or academic English knowledge” (p. 61).

Reading assessment data for all participants were provided to the researchers by the schools. At two schools, reading was assessed by means of the Stanford Tests of Achievement: Hearing Impaired (SAT-HI; Harcourt

Educational Measurement, 1996), and at the third school the reading subtest of the MAP (Northwest Evaluation Association, 2019) was used. As part of their investigation, the researchers administered three additional measures: (a) the ASL Assessment Instrument [ASLAI] (Hoffmeister et al., 2014), to assess ASL proficiency; (b) the CALS-I (Uccelli et al., 2014), to assess academic English; and (3) the Test of Silent Word Reading Fluency (Mather, Hammill, Allen, & Roberts, 2004), to assess word reading fluency.

Because two different reading outcome measures were used across the three schools, the researchers converted the MAP scores so that performance could be reported as SAT-HI mean scores and grade equivalents (GEs). As such, the findings indicated that the 21 White students achieved a score of 627.33 (approximately 4.4 GE) and the non-White students a score of 578.75 (approximately 2.3 GE). Achievement levels in both word reading fluency and academic English were below what would be expected given the students' age and grade. Overall, the students reportedly achieved an average score of 63.12 on the ASLAI. In their conclusions, the authors indicate that "ASL proficiency was consistently identified as the key predictor of reading comprehension" (Scott & Hoffmeister, 2017, p. 68). It was also reported that word reading fluency and academic English played a role, but this was not consistent across models. Although the researchers acknowledged the need to take a range of variables into account in future research (e.g., parental hearing status), race/ethnicity was the only sociodemographic variable to predict reading comprehension in this study.

DISCUSSION

The purpose of the present literature review was very straightforward—to determine the extent to which education in a

sign bilingual approach has affected the literacy achievement of deaf students. In the current context of deaf education, this is a particularly salient question, as expectations for attaining age-appropriate outcomes in reading and writing have never been higher. In a recent review of literacy outcomes of deaf learners with cochlear implants (Mayer & Trezek, 2018), it was found that, as a group, cochlear implant users were scoring in the average range with respect to reading in the majority of studies reviewed, a finding that points to a fundamental shift in thinking about attainment and reading outcomes for deaf students.

This finding stands in significant contrast to the findings of Qi and Mitchell (2012), who, in their analysis of the normative performance on the Reading Comprehension subtest of the SAT-9, noted that for almost 30 years, from 1974 to 2004, the median grade equivalent for any individual cohort of deaf students (aged 8–17 years) never exceeded the fourth-grade level. In light of this background and the current performance of deaf students with cochlear implants, it is fair to say that the achievement bar has been raised. This is not to suggest that all deaf students will have age-appropriate literacy achievement. In fact, there is a wide range of variability in the performance of students with cochlear implants, and the expectation that all of them would be equally successful would be unrealistic; this would not be a reasonable expectation even for a cohort of hearing learners. However, while it is recognized that there will be variability, it is the case that, in the current context, expectations are higher.

Based on this review of the literacy outcomes for deaf students in sign bilingual programs, it does not appear that the majority of students are evidencing higher levels of achievement. For example, the average reading comprehension scores

reported by Scott and Hoffmeister (2017) were a 4.4 GE for the White cohort and 2.3 GE for the non-White cohort, in a participant group in which the youngest students were enrolled in sixth grade. In the study by DeLana et al. (2007), only 6 of 25 students (24%) were reading at grade level. Across the three studies, C. M. Lange et al. (2013) reported the most encouraging findings, with 41% ($n = 25$) of study participants reading at or above grade level.

Research Design and Measures

It is interesting to note that in the three studies that were identified for the present review, the primary goal was not to report literacy outcome data. Rather, these outcomes were used as a means to document program efficacy (e.g., growth over time) (DeLana et al., 2007; C. M. Lange et al., 2013), or were utilized as the outcome variable (Scott & Hoffmeister, 2017). It is also worth noting that none of the researchers directly administered the outcome measure (i.e., reading comprehension) used in these investigations. Instead, they relied on existing data that had been collected in the school setting as part of the typical assessment protocol in that context (e.g., the NWEA-MAP).

While existing data can be a useful starting place, it is difficult to ensure the fidelity of test administration and scoring, and therefore the reliability and validity of the results. This observation is not intended to disparage the work done by the educators who have collected these data or the researchers who make use of the data, but, rather, to point out that when such data are relied upon, there needs to be a clear explanation of how these tests were administered and how scores are interpreted. When possible, administering additional assessments of literacy outcomes

would serve not only to provide additional data but also to strengthen the conclusions that were drawn. In fact, future research findings would be more robust if additional assessments of literacy were administered.

More generally, it would be worthwhile for researchers to conduct empirical investigations that employed research designs that allowed causality to be inferred from findings, such as group comparison and single-subject studies. We also recommend the use of widely regarded measures of achievement (e.g., the Woodcock Reading Mastery Test; Woodcock, 1987) that report findings using typical scoring metrics (e.g., standard scores, percentile ranks, grade equivalents) that allow a specific level of attained skill to be determined. In instances when less familiar assessments (e.g., the NWEA MAP) and scoring metrics—for example, Rasch Unit (RIT) scores—are used, researchers should provide thorough descriptions of the format of the measure and administration and scoring procedures, as well as sample items, to ensure that results can be readily interpreted.

It would also be important to include assessments of writing in future investigations. No studies that focused on writing met the inclusion criteria of the present review, a state of affairs consistent with that in literacy research generally (Troia, 2007) and in deaf education in particular, even for students with cochlear implants (Mayer & Trezek, 2018). That said, there were some studies (e.g., Scott & Hoffmeister, 2018; Singleton et al., 2004) that included written-language samples that provided a sense of the level of achievement of learners in sign bilingual contexts. For example, in the study by Singleton et al. (2014), the students identified as having moderate and high levels of ASL proficiency wrote in a

less formulaic fashion and incorporated more novel, low-frequency vocabulary than their deaf peers with low ASL ability. However, when reading the samples included in the study to illustrate the performance of the students who were more proficient in ASL, it becomes clear that the writing, a written retell of “The Tortoise and the Hare,” is neither age nor grade appropriate (e.g., “Turtle and Rabbit Race Try who win turtle”; Singleton et al., 2014, Appendix B, p. 101).

A similar observation could be made about the study conducted by Scott and Hoffmeister (2018). The researchers reported that in writing definitions for three common nouns (*anger*, *winter*, and *bicycle*), deaf students did not perform as well as their hearing monolingual peers, and this is evident when looking at the examples of written definitions included in the article—for example, “Bicycle is two wheel, and can any age can ride two wheel for fun with two wheel for fun or if can buy car then bicycle, so can ride go to school or work” (see Scott & Hoffmeister, 2018, Table 2, p. 177). As illustrated by this example, there are issues with respect to grammar and syntax that must be addressed, even when the meaning of the word has been captured to some extent in the definition.

With respect to the literacy development of deaf students, it appears that writing is an area that is in need of at least as much research attention as reading. One of the challenges for all researchers is that there are fewer standardized measures for writing than there are for reading, and while including writing samples is highly informative, these samples can be challenging to assess (see Mayer, 2010, for a discussion). However, this should not be a reason to neglect a focus on writing outcomes in considering the literacy achievement of deaf students in sign bilingual programs, especially at a time when written language plays

such a central role in the use of many current communication technologies (Kelly, Quagliata, DeMartino, & Perotti, 2016).

ASL and English Proficiency

Only one of the three studies (Scott & Hoffmeister, 2017) included a measure of ASL ability as part of the investigation, and in their conclusions these researchers suggested that ASL is associated with better reading outcomes. However, it is worth noting that reading outcomes were not strong overall (i.e., 4.4 and 2.3 GE), a finding that raises questions as to which aspects of reading comprehension were supported by higher levels of ASL. DeLana et al. (2007) did not include a measure of ASL in their study, but reported a “statistically significant correlation between years of ASL usage and reading achievement” (p. 73).

Given the theoretical foundation informing sign bilingual education (i.e., linguistic interdependence), it would seem worthwhile to include a measure of ASL proficiency in future investigations. As L1 proficiency is intended to serve as the foundation to allow for linguistic transfer to learning to read and write in L2 in a linguistic interdependence model, it would seem critical that a requisite level of L1 proficiency had been demonstrated.

Previous research has shown that this proficiency cannot be assumed and that there can be significant delays in the acquisition of a natural signed language as L1 for many deaf children (see Mayer & Leigh, 2010, for a discussion). Whenever there is a delay in the acquisition of the requisite proficiency in L1, the potential benefits of a sign bilingual education may not be fully realized. As well, it is problematic to argue that ASL is the foundation supporting literacy development (i.e., when students are meeting age-appropriate outcomes), if the

necessary ASL proficiency has not been established.

It should be recognized that assessing proficiency in a natural signed language can be challenging, as there are fewer measures available for this purpose than for assessing other aspects of language and literacy development (e.g., reading, English language). However, as Singleton and Supalla (2011) have reported, there are measures in use and in development, and therefore such measures should be included in future investigations as much as possible.

The extent to which (and how) English proficiency is focused on in future research also deserves consideration. In addition to measuring English proficiency by examining how deaf students use a written form of English, it would be important to determine the level of competence in a face-to-face form of English (i.e., L2). However, doing so would raise questions as to the appropriate means of assessing level of performance in a face-to-face form of English in a way that is equivalent to assessing ASL proficiency but does not disadvantage students who do not have strong speech skills (i.e., a student can have poor speech articulation but strong English language).

In any bilingual model of education that is informed by a theoretical framework of linguistic interdependence, it seems reasonable to consider language proficiency in both L1 and L2, and determine the extent to which this is affecting literacy achievement. None of the studies in the present review included a measure of face-to-face English proficiency, even though it was reported that many of the students used hearing technologies.

For example, DeLana et al. (2007) reported that 48% of students in their study used assistive listening devices, and Scott and Hoffmeister (2017) indicated that

66% of their study participants had either hearing aids (46%) or cochlear implants (20%). Scott and Hoffmeister did include a measure of academic English proficiency via a group-administered paper-and-pencil assessment (CALS-I) that was designed to examine students' ability to produce and understand language forms and structures present in academic English texts (e.g., morphologically related terms, words signaling organizational structure). While instructive, this is not equivalent to a measure of English-language proficiency (e.g., the Clinical Evaluation of Language Fundamentals; Wiig, Semel, & Secord, 2013). Without this information to inform the analysis, it is difficult to determine the nature of the impact L2 face-to-face proficiency has on L2 reading and writing outcomes.

Hermans, Knoors, Ormel, and Vanhove (2008) made this point when summarizing the findings of their investigation exploring the relationship between Sign Language of the Netherlands (SLN) and reading in Dutch. They reported that children who had good skills in written Dutch had good skills not only in SLN but also in spoken Dutch. On the basis of this finding, they argued that it was problematic to draw any conclusions about L1 proficiency in SLN and literacy in L2 (i.e., written Dutch). This observation demonstrated, Knoors et al. wrote, "the necessity of assessing deaf children's spoken language skills when the relationship between reading skills and signing skills is investigated" (p. 528).

Claims of an Evidence Base

The claims for the implementation of sign bilingual education and its efficacy are typically supported by a series of citations. However, upon closer examination, the literature that is appealed to often falls short if the research litmus test applied is

the demonstration of age-appropriate literacy outcomes. For example, to support his statements that “there is a direct transfer from ASL to English literacy” and that “students appear to have little difficulty in going directly from Sign Language to written language when their L1 (Sign) is well-developed,” Cummins (2009, p. 269) cites Mashie (1995) and Strong and Prinz (1997). However, the work by Mashie is a book, not an article, and although rich descriptions of sign bilingual programs are included, outcome data are not clearly reported, and there are no accompanying peer-reviewed publications that provide details about literacy achievement in these programs. While the Strong and Prinz (1997) study was published in a peer-reviewed journal, the findings indicate only that there is a positive relationship between stronger ASL proficiency and “higher English literacy.” The actual level of reading achievement is not reported, raising questions as to what is meant by “higher English literacy”—improved, but not to an age-appropriate level?

More recently, Humphries et al. (2014) have suggested that “abilities in a sign language and the ambient spoken language correlate to better reading skills” (p. 110); they support this claim with references to Clark, Begue, Gilbert, and Weber (2008) and Freel et al. (2011). The first reference is to a conference poster presentation, and in the second, Freel et al. report a passage reading comprehension mean score of 5.8 (GE) in a cohort of 55 deaf adults ranging in age from 18 to 43 years. A significant relationship was found between signing skills and English literacy, but the achievement levels were not clearly defined—that is, to what extent were the better signers meeting age-appropriate outcomes?

In another example of insufficient demonstration of age-appropriate literacy outcomes, Mellon et al. (2015) cite Strong

and Prinz (1997) and Padden and Ramsey (2000) when they state that signing deaf children with or without cochlear implants evidence better literacy performance. Strong and Prinz, in the article discussed above, and Padden and Ramsey, in a book chapter, do not report clear outcome data. There is no way to know if “better performance” means achievement that is age appropriate. Additionally, it is worth pointing out that in our 2018 review of literacy outcomes of students with cochlear implants (Mayer & Trezek, 2018), we did not find that the majority of students used sign language, and outcomes were in the average range for the majority of participants in 19 of the 21 studies we reviewed.

In 2000, Cummins wrote,

Controversies surrounding bilingual education for Deaf children—specifically the extent to which American Sign Language should be used as a medium of instruction—and the degree to which linguistic and conceptual transfer will occur from ASL to written English continues to be a high-stakes issue. (p. 29)

If these controversies are to abate, and if there is to be a viable future for sign bilingual programs, at least with respect to their efficacy in developing age-appropriate literacy outcomes for deaf learners, much more research attention needs to be paid to building the empirical evidence base in support of the theoretical claims. Particularly at a time when advances in hearing technologies afford the majority of deaf children meaningful access to spoken language, the need for signed communication to provide linguistic access is diminished, most especially for the more than 95% of deaf children who have hearing parents. This gives even greater urgency to the need for researchers to provide the outcome-based evidence to demonstrate that sign bilingual

education is a pedagogical path, not only to the development of fluency in ASL but also to text-based literacy in English.

Limitations

As with any review, potential limitations need to be acknowledged. Although multiple strategies were employed to identify studies, some publications may have been unintentionally overlooked. In addition, a decision was made to limit the review to studies published in peer-reviewed journals, and thereby exclude other forms of scholarly publication (e.g., chapters in edited volumes, conference proceedings, dissertations). Finally, the focus of the present review was exclusively on studies of bilingual education contexts in which the majority spoken/written language is English (ASL/English, BSL/English, South African Sign Language/English, Auslan/English, etc.). Consequently, studies that reported findings in settings where the majority language was not English (e.g., SLN/Dutch, Norwegian Sign Language/Norwegian, Italian Sign Language/Italian) were not included, even if the study itself was published in English (e.g., Hermans et al., 2008; Kristofferson & Simonsen, 2014; Teruggi & Gutiérrez-Cáceres, 2015).

CONCLUSIONS AND IMPLICATIONS

The most salient aspect of the activity of reviewing the current state of the knowledge with respect to the literacy outcomes of students in sign bilingual programs is the significant lack of research. Given that these programs have been in place for almost three decades, and that literacy achievement continues to be a critical issue in the field, the existing state of the research is untenable. There were only three studies of reading achievement available for review, and none that explored writing

outcomes. There was also no evidence that very many sign bilingual programs, some of which have been in place for a substantial period, tracked literacy outcomes. If they did, this information is not reported in the peer-reviewed literature. The need for more research could not be clearer, particularly for investigations that report achievement in *both* reading and writing in ways that can be readily and meaningfully interpreted (i.e., the use of accepted, standardized measures). Investigations of writing are especially warranted, as there were none available for review.

Given that the impact of education in a sign bilingual program would not be immediately evident, studies should be designed that track participants' performance over time. It would be important to understand the rate and pace of literacy development, and the factors that influence progress, as well as the extent to which students achieve age-appropriate outcomes as a consequence of attending these programs. An argument for this type of longitudinal investigation was made by the authors of one of the studies in this review (i.e., C. M. Lange et al., 2013). Designing and undertaking multiple-year longitudinal investigations would be a powerful means of providing research evidence in support of the claim that sign bilingual education is an approach that supports the literacy development of deaf students.

Whatever the research approach, the measurement and reporting of levels of achievement both merit careful consideration, as outcomes need to be clearly stated. Standardized measures should be employed whenever possible utilizing reporting metrics (e.g., standard scores) that allow for the meaningful comparison of findings across studies and participants even when a wide age range is included. Such metrics also afford the opportunity to determine how well deaf students are achieving in reading and

writing with respect to their hearing-age peers, a benchmark that has become the standard against which success is increasingly being measured.

In reporting writing outcomes, the inclusion of writing samples, in conjunction with the use of standardized measures (e.g., the Test of Written Language; Hammill & Larsen, 2009), would enhance the description of performance in this area and provide a more complete picture of whether students educated in sign bilingual programs have control of written language. It would also be worthwhile for researchers to think more carefully about the demographic characteristics of study participants that warrant inclusion (e.g., level of signed language proficiency, presence of additional disabilities, parental hearing status, use of hearing technologies, etc.) as possible variables with an impact on literacy outcomes.

In light of the scant available evidence base, it is not possible to say with any confidence that deaf students educated in sign bilingual programs are achieving outcomes that are significantly better than those that have been historically reported for this population. Outcomes for the vast majority are not at or approaching age-appropriate levels when considered in terms of the performance of their hearing peers. Empirical evidence for the anticipated positive shift has not been realized, at least insofar as we have studies to review to make the case. While it would be fair to say that improvements and gains were evident over time for many students (i.e., progress was made), this did not generally result in outcomes that were commensurate with age and grade placement.

NOTE

1. The CAEBER website (<http://caeber.gallaudet.edu>) is no longer available.

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