

Supplemental Material S1. PRISMA table.

Section	Topic	Item	Checklist Item
Title	Title	1	<p><i>Identify the report as a systematic review, meta-analysis, or both.</i></p> <p><u>A systematic review</u> of evidence-based speech, language, and literacy interventions for deaf and hard of hearing and/or multilingual learners</p>
Abstract	Structures summary	2	<p><i>Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</i></p> <p>Purpose: <u>Many educators and speech-language pathologists have difficulty providing effective interventions to the growing population of d/Deaf and hard-of-hearing (DHH) learners who use more than one language (background). The purpose of this review was to identify evidence-based interventions for speech, language, and literacy used with DHH multilingual learners (DMLs), monolingual DHH learners, and hearing bilingual learners without hearing loss. Interventions used with these groups can inform the practice of professionals providing services to DMLs (objective).</u></p> <p>Method: <u>This review considered speech, language, and literacy interventions used with DHH and hearing bilingual learners from birth to 21 years of age (participants). The following electronic databases were searched: Academic Search Complete/EBSCO (CINAHL, Education, ERIC), Linguistics, Language, and Behavior Abstracts (LLBA), PsycInfo, and PubMed (data sources). Data describing article, participant, methodological, and intervention variables were extracted from studies. The methodological quality of studies was examined using the Council for Exceptional Children's (2014) standards for evidence-based practice in special education (study appraisal).</u></p> <p>Results: <u>A total of 144 studies were reviewed, describing over 9,370 learners aged 1.8 to 22.0 years. Two studies investigated DMLs, 76 investigated DHH learners, and 66 investigated hearing bilingual learners. A total of 146 different interventions were examined. Most studies reported positive effects. Only 17 studies met all quality indicators and were examined to determine if they could be considered evidence-based interventions. Only 17 studies met all quality indicators specified by the Council for Exceptional Children (2014): seven examined DHH learners and 10 examined hearing bilingual learners. There was insufficient evidence for any single intervention to be considered an evidence-based intervention, although six could potentially contribute to evidence-based practice (results).</u></p>

			<p>Conclusions: <u>No evidence-based interventions for DMLs were identified. A small number of interventions examined in high-quality studies of DHH and hearing bilingual learners were identified (conclusions), which may be appropriate for use with DMLs following further investigation (implications).</u></p> <p>Not addressed in this abstract: Study eligibility criteria, limitations</p> <p>Not applicable for this review: Interventions, synthesis methods, systematic review registration number</p>
Introduction	Rationale	3	<p><i>Describe the rationale for the review in the context of what is already known.</i></p> <p>See section of introduction titled "Rationale for this Systematic Review"</p>
	Objectives	4	<p><i>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</i></p> <p>See section titled "Rationale for this Systematic Review"</p> <p>See Table 2 for PICOTS information</p>
Methods	Protocol and registration	5	<p><i>Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.</i></p> <p>PRISMA-P table documenting the protocol for this study is available from the authors on request</p> <p>This systematic review was not eligible for registration with PROSPERO</p>
	Eligibility criteria	6	<p><i>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</i></p> <p>Exclusion Criteria</p> <ol style="list-style-type: none"> 1. Published before 1992: Hearing aid and cochlear implant technology, intervention, and pedagogy for DHH children has changed greatly, especially following the advent of the cochlear implant. Therefore, only articles published within the last 25 years were considered, which is after cochlear implantation in children began. 2. Not research articles published in a peer-reviewed journal: Potential sources were limited to those published in peer-reviewed journals to assist in constraining the search to articles demonstrating methodological rigor and well reported research. 3. Did not describe pre- and post-intervention data from an intervention for speech perception, speech production, spoken language and/or literacy, e.g., direct instruction or intervention were included, but parent engagement, strategies observed to be used, or intervention preferences were not. The interventions described were required to be interventions

		<p>appropriate for use in an education or clinical setting by an SLP or educator e.g., educator delivered reading intervention were included, but CI processing strategies, hearing aid bandwidth compression, or evaluations of whole educational programs or approaches to education were not.</p> <ol style="list-style-type: none"> Intervention described did not directly target children or young people. For this criterion, at least half of all participants in the study needed to be under the age of 21 years, or data had to be presented in such a way that the results of participants aged under 21 years could be examined separately. The age of 21 years was chosen so as to capture learners enrolled in school-based K-12 programs with IEPs, which can continue until learners are 21 years old. Participants in the study were not learners with hearing loss and/or learners who used more than one spoken language. Participants diagnosed difficulties or disabilities (excluding hearing loss), such as Autism Spectrum Disorder, learning disability, and developmental delay. Full text was not able to be obtained after extensive searching and inter-library loan requests through three different university libraries. <p>Note: The language in which the article was published was not an exclusion criterion.</p>
Information sources	7	<p><i>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</i></p> <p>The following electronic databases were searched in September 2017: Academic Search Complete/EBSCO (CINAHL, Education, ERIC), Linguistics, Language, and Behavior Abstracts (LLBA), PsycInfo, and PubMed.</p> <p>There was no contact with study authors</p>
Search	8	<p><i>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</i></p> <p>See Supplementary Material: Search Strategy</p>
Study selection	9	<p><i>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).</i></p> <p>Study selection: See Item 6</p> <p>Inclusion in consideration for evidence-based interventions: Studies were required to meet all of the quality indicators relevant to their research design to be considered for inclusion. The quality indicators used were those from the Council for Exceptional Children (2014).</p>

		Council for Exceptional Children. (2014). Council for Exceptional Children: Standards for evidence-based practices in special education. <i>Teaching Exceptional Children</i> , 46(6), 206-212. doi:10.1177/0040059914531389
Data collection process	10	<p><i>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</i></p> <p>Data extracted: Article variables included authors' names, year of publication, and the language the article was written in. Participant variables included the country in which data were collected, number of participants, participants' ages, the participant groups investigated (e.g., DHH, bilingual), language/s, language status (e.g., monolingual, multilingual, bimodal bilingual), hearing status (DHH, hearing), and hearing devices used (hearing aid, cochlear implant). The methodological variable was study design (correlational [COR], crossover [CRO], experimental group comparison [EGC], single-case research [SCR]). Intervention variables included the name and description of the intervention, setting in which the intervention was delivered (e.g., clinic, education), target of intervention (e.g., speech, spelling), intervention provider (e.g., educator, SLP), and outcome of the intervention..</p> <p>Data extraction method: Speech-language pathology student research assistants conducted trail data extraction on all articles. Refinements to coding were made and then the data presented in this review were extracted by the first author. Where an article was in a language other than English, data were extracted by a member of the research team who could read that language or by a colleague who was fluent in that language and an experienced researcher in the field of speech, language, and DHH learners.</p> <p>Inter-rater reliability for data extraction: Inter-rater reliability was considered at multiple points by blindly calculating point-by-point agreement. Reliability for data extraction was 85.4% (528 data points, 22 articles, 15% of the sample) and 86.4% (616 data points, 22 articles, 15% of the sample) for study quality.</p>
Data items	11	<p><i>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</i></p> <p>See Table 2</p>
Risk of bias in individual studies	12	<i>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</i>

			Bias in individual studies was identified by application of the Council for Exceptional Children's quality indicators. The results of these are shown in Supplementary Material (Study Information) for individual studies, and Table 3 for the entire sample.
	Summary measures	13	<i>State the principal summary measures (e.g., risk ratio, difference in means).</i> No statistics analyses were undertaken. Proportional (percentage) and descriptive statistics were presented where appropriate for describing the sample.
	Synthesis of results	14	<i>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.</i> Results of studies were not synthesized in this review.
	Risk of bias across studies	15	<i>Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).</i> Bias was not able to be formally assessed in the included studies. However, it is noteworthy that nearly all of the 144 studies reported a positive impact of the intervention on at least one dependent variable post-intervention so it is likely that publication bias is a factor to keep in mind when interpreting the results of this systematic review.
	Additional analyses	16	<i>Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.</i> No additional analyses were conducted.
Results	Study selection	17	<i>Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.</i> See Figure 1.
	Study characteristics	18	<i>For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.</i> See Supplementary Material (Study Information).
	Risk of bias within studies	19	<i>Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).</i> See Supplementary Material (Study Information).
	Results of individual studies	20	<i>For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.</i>

			This was not conducted for all studies due to (a) the diverse interventions investigated, and (b) the poor methodological/reporting of the majority of studies. For studies that were of sufficient quality effect sizes were presented or calculated (see Table 5).
	Synthesis of results	21	<i>Present results of each meta-analysis done, including confidence intervals and measures of consistency.</i> A meta-analysis was not conducted.
	Risk of bias across studies	22	<i>Present results of any assessment of risk of bias across studies (see Item 15).</i> Publication bias was not able to be formally assessed (see Item 15)
	Additional analysis	23	<i>Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).</i> No additional analyses were conducted.
Discussion	Summary of evidence	24	<i>Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).</i> The main outcome was that no interventions met the criteria for creating an evidence-base for practice and this is stated "There were no interventions that were examined by enough studies of high-quality for them to be considered as part of the evidence-base for practice at this stage. However, six were classified as having potential to inform EBP. This review clearly demonstrated that a gap exists in the literature concerning evaluation of interventions for DMLs, with only two studies targeting this population of learners identified".
	Limitations	25	<i>Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).</i> Limitations of the literature: see section titled "Limitations of the Literature" Limitations of this review: see section titled "Limitations of this Review"
	Conclusions	26	<i>Provide a general interpretation of the results in the context of other evidence, and implications for future research.</i> Implications for future research: see section titled "Recommendations for the Literature"
Funding	Funding	27	<i>Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.</i> Financial Disclosure: This project was conducted in the course of the authors' usual employment and did not receive external funding.

Authorship Disclosure: KC is the guarantor and drafted the manuscript. Both authors contributed to the development of the search strategy, inclusion/exclusion criteria, and data extraction criteria. KC extracted the data, applied quality indicators, and examined intervention evidence-base in consultation with MG. Both authors edited, read, provided feedback, and approved the final manuscript.

Note. Italicized text is a direct quotation from Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & the PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine*, 151(4), 264–269. <https://doi.org/10.1059/0003-4819-151-4-200908180-00135>