A SYSTEMATIC LITERATURE REVIEW TO EXPLORE THE IMPACT OF USING SIGNED LANGUAGES ON THE INCLUSION OF D/dEAF AND HARD-OF-HEARING (DHH) CHILDREN.

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ABSTRACT

This dissertation focuses on the inclusion experienced by Deaf and hard-of-hearing (DHH) pupils within an international context. It conducts a systematic review of literature which examines the current practice in the global education of DHH children. Additionally it interrogates the inclusivity of different education modalities in relation to the barriers faced by DHH students. It offers conclusions regarding the efficacy and requirements of the bimodal bilingual education programmes found in various international situations as well as other interventions designed to improve the achievement and inclusion of DHH learners. The conclusions suggest the importance of early intervention with DHH children as well as suggesting a need to capitalise on advances in technology to improve the inclusion and achievement of DHH learners. Finally, it offers implications for future research and practice based on the findings of this review, recognising in particular, the need for further research within a UK – and specifically a Scottish - context.

INTRODUCTION AND RATIONALE

With the passing of the BSL (Scotland) Act in 2014 (Scottish Government, 2014) and the recent announcement of the BSL National Plan (Scottish Government, 2017), British Sign Language (BSL) and its place in Scottish Education is a matter of real debate.

Within the D/deaf community, the use of sign languages in education has historically been subject to discussion (Leigh & Marschark, 2016; Morrison et al, 2013; Marschark et al, 2015; Marschark et al, 2011; Marschark et al, 2012; Lesar & Vitulic, 2014; Bedoin, 2011; Kontra et al, 2015; Doherty, 2012; Bat-Chava, 1993) and the debate around it remains fierce and controversial. Traditionally, parents of D/deaf and hard-of-hearing (DHH) children have not been encouraged by Health and Education professionals to learn or use BSL as a means of communicating with their DHH child (Bat-Chava, 1993) – with a focus tending to be more towards a deficit model of D/deafness (i.e. a medical condition requiring a cure) rather than as a difference to be acknowledged (NHS Newborn Screening Programmeme, 2007; Kontra et al., 2015; Bat-Chava, 1993). Whilst some members of the D/deaf community argue that this is necessary for DHH children to learn to survive in the hearing world (Second International Congress on Education of the Deaf, 1880), other members of the D/deaf community argue that it is only through learning a signed language as their first language that DHH children will be able to access spoken (and written) language and thus participate in hearing society (Marschark et al, 2015; Kontra et al, 2015; Doherty, 2012). The controversy has meant that educationally there are tensions around provision for DHH learners – and there have been for generations.

Historically, DHH children in specialist provision within mainstream schools or in mainstream education itself, have been prohibited from accessing education through a signed medium (Second International Congress on Education of the Deaf, 1880) and anecdotal evidence from DHH adults would suggest that DHH children were historically punished for using signed languages even during social times at school (Staff Writer (Deaf Friendly), 2013). Conversely, pupils at specialist D/deaf schools, such as Donaldson's School in Edinburgh, were often taught and encouraged to use sign

language (Voluntary Action Fund, 2013) and thus the educational provision often differed radically according to geographical location or socio-economic status which, of course, determined the provision available to children. Nowadays, D/deaf pupils in Scotland are largely educated within specialist mainstream 'units' or within mainstream classrooms (Consortium for Research in Deaf Education, 2015) with some input from Teachers of the Deaf (ToD) – many of whom have only basic sign language skills and/or are not fully qualified as ToD (Consortium for Research in Deaf Education, 2015). All of this history means that the debate is not only political, but also highly emotive thus potentially leaving educational outcomes to be obscured or even lost among the political and emotional.

Internationally, policies surrounding the use of signed language appear to vary dramatically (Doherty, 2012; Marschark et al., 2015; Marschark et al., 2012; Lesar & Vitulic, 2014; Bedoin, 2011; Marschark et al., 2011; Kontra et al., 2015) and international research seems to explore the assertion that, traditionally, DHH pupils appear to attain less highly than their hearing peers (Kontra et al., 2015; Eden, 2014; Marschark et al., 2012; Marschark et al., 2011; Marschark et al., 2015; Morrison et al., 2013), thus questioning which of the interventions employed in the international sphere appear to have the most impact in addressing this apparent attainment gap.

Additionally, outwith this debate, there are various related issues. Hearing impairment is not the only communication impairment which may impact the achievement of learners. For example, similar comprehension and linguistic issues may face English as an Additional Language (EAL) pupils (Demie & Strand, 2006), many of whom arrive in the UK with little or no prior knowledge of English. Indeed, as an added complexity, if DHH children were to have sign language as their first language, they too would effectively have English as a second language – or even be raised as bimodal bilingual (Doherty, 2012; Bedoin, 2011). Evidently it would be untenable to suggest that EAL pupils be provided with interpreters of their own native language and yet the argument often is that DHH pupils should be taught through the medium of signed language, whether that be in specialist or mainstream provision; through the class teacher or through an interpreter (Doherty, 2012).

Equally, there would inevitably be debate pertaining to the level of D/deafness required prior to these sign language provisions being made, with hearing loss following a continuum from that categorised as 'mild' to 'profound' (NHS Newborn Hearing Screening Programme, 2007). This debate would need to consider the provision available to children who are hearing impaired as a result of prolonged but temporary hearing impairment such as glue ear (Capewell, 2014), in addition to those pupils with mechanical aids to hearing, such as radio aids or cochlear implants. DHH learners are not an homogeneous group, nor do they have homogeneous linguistic experiences (Marschark et al., 2012; Marschark et al., 2015; Doherty, 2012; Bedoin, 2011; Kontra et al., 2015) and thus considerations regarding the use of signed language in education are complex. Further, given the political and emotional historical background to D/deaf education, it must be considered that this is not necessarily the sole responsibility of education and that other service providers may have an equal – or perhaps even greater – responsibility.

RESEARCH PROPOSAL

As a teacher of English (and Literacy) – a subject which has its basis in an ability to communicate effectively – and someone who has an interest in D/deaf culture after learning basic BSL, the aforementioned factors are all, in my opinion, significant educational considerations.

From the research which I have previously carried out pertaining to the inclusion of DHH learners from an international perspective and the development of literacy amongst DHH learners, certain issues appear to arise. Firstly, there would appear to be a paucity of literature from a UK context, suggesting that there is a need for future research in the UK generally, and specifically in the Scottish context. Secondly, there would appear to be a paucity of literature pertaining to contexts which intervene through signed teaching methods such as those employed in Scandinavian countries (Kontra et al., 2015; Doherty, 2012), implying that there are few countries which employ these methods. Yet this use of signed interventions is an area of real interest and thus will

form a significant basis of this dissertation. Finally, the emotional and political elements of the debate potentially leave research and political opinion polarised and following an agenda. Thus this research will be as free from political or emotional bias as possible.

Having said all of that, within the current political climate in Scotland – and with increasing political pressure in the wider UK to promote the learning of BSL –a systematic literature review of existing international research, examining the use of signed languages and their resultant impact on the inclusion of D/deaf and hard-of-hearing learners, is a starting place to explore the support available. Leading, therefore, to the research task: "A systematic literature review to explore the impact of using signed languages on the inclusion of D/deaf and hard-of-hearing (DHH) children".

RESEARCH METHODOLOGY

Given the tendency for DHH learners to be educated within mainstream environments in Scotland (Consortium for Research in Deaf Education, 2015) this proves problematic for the gathering of primary data due to the spread of the population of this group of learners. Compound this with the historic tendency to prohibit the use of sign language within educational establishments (Second International Congress on Education of the Deaf, 1880) and the number of institutions internationally which utilise signed interventions, and again, the collection of primary data proves challenging. For this reason, the rigorous exploration of pre-existing data in the form of a literature review allows for a larger scope to "'access' your database much more easily than in organisational research" (Curtis, et al., 2014, p. 144). It also enables the ability to revisit the subject – which may not be possible with widespread subjects (Curtis, et al., 2014).

Moreover, as previously highlighted, the specific group of DHH learners is one which is not homogeneous (Marschark et al., 2012; Marschark et al., 2015; Doherty, 2012; Bedoin, 2011; Kontra et al., 2015) and thus the study of DHH learners is a field containing a multitude of variables. Additionally, the political and emotional climate surrounding the education of DHH learners is such that there is potential for bias, both

within the researcher and within the subjects of the research. As a result of these potential difficulties concerning research into DHH education, a systematic review of literature would seem to be a worthwhile approach. The systematic nature of this review would ensure that it is rigorous and explicit in its search for literature and selection thereof (Torgerson et al., 2012; Newman & Dickson, 2012) ensuring that there are transparent inclusion criteria for literature selection, thus allowing the researcher legitimately to limit the number of variables potentially affecting the impact of the intervention being examined – in this case, the use of signed language intervention in education. Further, the systematic approach to the search for and selection of literature minimises reviewer bias (Torgerson, et al., 2012) as it searches the totality of research conducted within a particular field, using transparent and explicit criteria – indeed, as Curtis et al. (2014) explain: "the scope of [...] documentary research is only limited by the availability of the documents themselves" (p. 144). Further, they go on to explain that, given that the subject of the research within a documentary analysis such as a literature review, is a passive rather than an active participant (and that any potential bias within the documents would be open to interpretation by the researcher), this further creates objectivity (Curtis, et al., 2014) and thus should help to eliminate the political and emotional bias commonly associated with DHH education.

In essence, this minimising of reviewer bias maintains the scientific rigour of an objective positivist epistemology, whilst recognising that the knowledge and understanding gained from a systematic review of literature is, by its very nature, interpretivist: constructing meaning out of the collation of systematically selected data. Thus, this systematic literature review exploring the impact of the use of signed languages on the inclusion of DHH learners inhabits the constructivist ontology and interpretivist epistemology, whilst concurrently retaining objectivism and minimising researcher (and subject) bias.

RESEARCH METHODS

Literature Search

In beginning the search for literature, key words were identified from the research task: "A systematic literature review to explore the impact of using signed languages on the inclusion of D/deaf and hard-of-hearing (DHH) children". These key words ('signed languages'; 'inclusion' and 'D/deaf and hard-of-hearing students) are essential in forming, not only the basis of the search but also the basis of the selection process, given that search and selection are intrinsically linked (Newman & Dickson, 2012). These were used, along with synonyms, to create partial searches in order to ensure that all search terms were valid. The searches were entered onto a digital library network and when all fields were searched (including synonyms), the search used the following terms: *signed languages* OR *sign language* OR *BSL* AND *inclusion* OR *inclusive education* AND *D/deaf and hard-of-hearing children* OR *DHH children* OR *D/deaf and hard-of-hearing learners* OR *DHH learners*. This search returned 134 results using these specific and explicit search terms.

Initial Inclusion and Exclusion Criteria

Once a search had been generated on the digital library network, the 134 results were refined using strict inclusion and exclusion criteria in order to ensure a systematic approach to selection (Torgerson, et al., 2012). The following criteria were applied in order to refine the search, Peer-reviewed articles; books (or book chapters); conference proceedings; Government documents; Papers; Publications and Reports were included. The results had to have been published within the last five years (from 1st January 2013) in order to ensure the most up-to-date academic literature and had to have been published in English. The results were further refined to be within the discipline of Education, as D/deafness is an area which is often researched and published within a variety of fields (Marschark, 2015) and this ensures relevance within one particular field. Finally the search was asked to exclude Newspaper Articles; Book Reviews and Dissertations/Theses to guarantee published, peer-reviewed and academically rigorous literature. These criteria generated 35 results.

Further Inclusion and Exclusion Criteria

These results were then placed in a table which applied further inclusion and exclusion criteria (see Appendix 1). The title of each article was read in order to identify whether it implied or explicitly mentioned *DHH education*; *sign language*; *inclusion* or any other relevant factor or intervention. If the article explicitly or implicitly referred to three out of four of these areas and did not contain multiple other variables (i.e. spoken multilingualism in addition to sign multilingualism; additional disabilities) then the article was included for review. It was also noted whether the title of the article implied a focus on a specific subject – although this was not used as a criterion for exclusion or inclusion. Using these inclusion and exclusion criteria, 23 articles were discounted, leaving 12 articles for review.

Bibliography Review

The bibliographies of the twelve selected articles were then reviewed for post-2013 publications resulting in an additional 84 articles. These were further reviewed for duplications (marked in orange on Appendices 1-5); whole books (which were deemed to be too lengthy for systematic review) and for references to D/deafness and/or hearing loss. From this review, 20 results were discounted, leaving 64 potentially relevant articles. These were subsequently entered into another table containing the same inclusion and exclusion criteria as in Appendix 1, in addition to three extra criteria: was the article peer-reviewed; was the article available within the field of education; and was the article available under the previous search parameters on the digital library network (see Appendix 2). A caveat was added to these criteria, in that a number of the 64 results were Book Chapters which did not show up when the peer-review parameter was selected. However, given that these chapters were included within academic books, it was decided that they would be academically (if not peer) reviewed and thus were suitable for inclusion. From the 64 results, therefore, 9 articles met the eligibility criteria based on Title analysis.

Bibliography Review: Two

The nine additional bibliographies were also reviewed and found to contain 78 post-2013 articles (plus two articles published in Spanish which were therefore discounted). Once articles were excluded on the basis of duplication; whole books and lack of

reference to D/deafness or hearing loss, 49 articles were analysed by title using the inclusion and exclusion criteria table as before (see Appendix 3). From this, a further 10 articles were selected.

Bibliography Review: Three

The bibliographies of these ten articles were also reviewed for post-2013 literature, of which there were 45 examples. After exclusion on the basis of duplication; whole books and lack of reference to D/deafness or hearing loss, 19 titles were analysed using the inclusion and exclusion criteria table (see Appendix 4) and 2 articles remained.

Bibliography Review: Four

From these remaining 2 articles, there were 15 references to post-2013 literature, of which 7 remained after exclusion due to duplication; whole books and lack of reference to D/deafness or hearing loss. Of these 7, there were 0 articles which fulfilled the additional inclusion and exclusion criteria (see Appendix 5)

Abstract Analysis

The final selection of the literature was based on analysis of the Abstracts. The Abstracts of the 33 relevant articles were read in order to identify the use of three key terms or synonyms thereof (see Appendix 6). Thus the abstracts of all 33 remaining articles were read for the following qualifying terms:

- *Signed Language(s)*; s*ign language(s); signing / signed / signer; BSL; ASL; bimodal / multimodal (communication); language / communication mode / modalities; sign bilingual; total communication; simultaneous (communication)*
- *Education; teaching; learning; academic; learners; students; pupils; teachers; educators; school; college; university; classroom*
- *Inclusion; inclusive; outcomes; HWB; academic achievement / attainment / performance / success / progress / growth; social integration; early intervention; accommodation; differentiation; adaptation; development / develop*

In order for the article to be included within the systematic review of literature, it had to reference all three of the terms (or synonyms thereof) in order to justify its inclusion. Abstract analysis resulted in a set of 17 pieces of literature to be reviewed.

RESULTS

Of the seventeen articles reviewed, five took the form of case studies involving small groups of learners and five were surveys involving large numbers of individuals. Two of these five were longitudinal surveys revisiting participants over a number of years. The remaining seven articles were reviews of previous literature. Out of the ten articles in which data collection took place, data was gathered in the USA for eight of the articles: the remaining two discussed data gathered in Hong Kong and in Spain. Seven out of the seventeen articles explicitly mentioned the requirement for further research, often citing a lack of relevant research (and specifically a lack of empirical research) in the field.

In terms of the subjects covered within the articles, eleven of the seventeen specifically discussed or focused on bilingual (and / or bimodal) education of DHH learners, with six articles out of the seventeen recommending bilingual bimodal education as a means of ensuring the academic achievement and inclusion of this group of learners. Eight articles discussed measures regarding reading and / or literacy with regard to the academic success of DHH learners and three referred to mathematical skills to demonstrate this. Additionally, four articles referred to cognitive skills or executive functioning when exploring the academic successes of DHH learners and thus literacy skills, mathematical skills and cognitive skills are all areas measured within these ten articles in order to assess the effects of educational systems, settings and / or interventions. Other areas considered within the seventeen articles were: social-emotional status of DHH learners; the use of virtual reality or avatars to support the inclusion of DHH learners; the impact of an alternative language intervention on a group of DHH learners; the effects of socio-economic status (SES) on the linguistic

achievement of DHH learners; the impact of cochlear implantation on inclusion and whether DHH students exhibit a visual learning style.

In addition to the six articles recommending the use of bimodal bilingual education to support DHH learners, five stressed the need for practitioners to ensure adequate differentiation in order to meet the needs of DHH learners. Four out of these five articles, however, recognised the challenges involved in this differentiation, as they (and four additional articles) also explained that DHH learners are not an homogeneous group – indeed, multiple factors can affect their academic achievement.

Table 1 (overleaf) provides a comprehensive summary of the variables outlined in relation to the articles.

See Appendix 7 for detailed information regarding all seventeen articles.

Table 1: Article Summary

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Citation	(Berke, 2013)	(Lange, et al., 2013)	(Marschark, et al., 2013)	(Vesel & Robillard, 2013)	(Bennett, et al., 2014)	(Ormel & Giezen, 2014)	(Yiu & Tang, 2014)	(Martin, et al., 2014)	(Marschark & Lee, 2014)	(Walker & Tomblin, 2014)	(Twitchell, et al., 2015)	(Marschark, et al., 2015)	(Zirzow, 2015)	(Guardino & Cannon, 2016)	(Nielsen, et al., 2016)	(Marschark, et al., 2016)	(Knoors, 2016)
Country	USA	USA	USA	USA	USA	n/a	Hong Kong	Spain	n/a	n/a	USA	n/a	n/a	n/a	USA	USA	n/a
Case Study	✓			✓	✓		✓							✓			
Survey		✓	✓					✓			✓					✓	
Literature review						✓			✓	✓		✓	✓	✓			✓
Further / lack of research		✓		✓					✓	✓		✓		✓	✓		
Bimodal / bilingual education	✓	✓				✓	✓	✓	✓	✓	✓				✓	✓	✓
Reading / literacy	✓	✓	✓	✓					✓		✓				✓		
Mathematics		✓	✓	✓													
Cognitive skills			✓			✓						✓				✓	
Social-emotional impact							✓	✓				✓					
Virtual reality / avatars				✓									✓	✓			

Language intervention					✓													
Effects of SES										✓	✓							
Visual learners			✓													✓		
Impact of CI						✓		✓		✓								
Recommend bilingualism						✓	✓	✓	✓	✓								✓
Recommend differentiation									✓			✓		✓			✓	✓
Heterogenity / many factors	✓							✓	✓	✓		✓		✓	✓			✓

DISCUSSION

As illustrated in the results section, there are a number of themes which can be seen to emerge from this reading, all of which warrant further discussion in consideration of the inclusion of DHH pupils. Accordingly, discussion of these distinct themes should take place prior to conclusions being drawn and implications considered.

ACADEMIC IMPLICATIONS

When considering inclusion in education – and especially in a Scottish context – it is important to consider academic success, given that 'Achievement' is one of the eight SHANARRI indicators on the Curriculum for Excellence Health and Wellbeing Wheel (Scottish Government, 2014).

Literacy and Reading

Many of the studies reviewed considered the literacy levels and literacy acquisition of DHH students worthy of exploration. Marschark & Lee (2014) indicate that this focus on literacy is largely unsurprising, given that literacy essentially underpins all academic success, and that the achievement of DHH pupils in literacy is a potential concern given the likelihood of complex linguistic backgrounds – at best, DHH pupils are learning to read in their second language (Marschark & Lee, 2014). Twitchell et al. (2015) summarise this when they explain:

> "Deaf children may be surrounded by books but not have sufficient language to benefit from the stories the books hold. They may have rich and engaging conversations with their parents in ASL, but rarely receive encouragement to put their stories into writing. When both factors come together to support the developing deaf learner, successful literacy achievement is a likely outcome." (p. 444)

Nielsen et al. (2016) also explain that reading success is often predicated on an awareness of parts of spoken language which are often missing from signed languages. This lack of morphological awareness disadvantages those children who are unable to hear these tiny parts of language, or morphemes – such as prefixes and suffixes – as

their lack of awareness prevents them from identifying and decoding them. Similarly, difficulty in accessing vocabulary can also hinder the literacy development of DHH pupils (Vesel & Robillard, 2013).

What appears clear is that there are certain interventions which may support DHH pupils in developing real success in literacy learning. Berke (2013) examined the reading strategies of DHH mothers with their DHH children and found that they instinctively employed various strategies to support the child's reading development. They made explicit links between the phonology (and thus the morphology) of written English and the phonology (or handshapes) of ASL. Berke (2013) found that the mothers consciously explained differences between the two languages, providing their child with additional support in terms of mechanisms such as spelling, rhyming, varied font sizes and definitions of words. In this way, the DHH mothers made written English explicit in such a way as to build their DHH child's literacy development. Berke (2013) suggests that, in many ways, DHH children of hearing parents (DoH) could benefit from their parents learning to read in this way with them. In one strategy in particular, where DHH mothers signed using the written English word order, Berke (2013) suggests that this may boost the confidence of hearing parents who may find switching between the two modalities difficult.

Despite these positive strategies discovered by Berke, however, Marschark et al. (2013) caution that DHH pupils with DHH parents (DoD) do not necessarily achieve language milestones concurrently with hearing peers. Additionally, given that only 5% of DHH children are born to DHH parents (Marschark et al., 2013; Yiu & Tang, 2014; Twitchell et al., 2015), there is still a huge number of DHH children who do not have the benefit of a DHH parent scaffolding their literacy development. Bennett et al. (2014) and Nielsen et al. (2016) both explore specific language interventions designed to improve literacy outcomes. Bennett et al. (2014) consider an extraction model (Language for Learning) in which English is taught 'through-the-air' (i.e. signed and spoken) to small groups of pupils providing exposure to English and providing systematic ways of teaching the necessary elements of language for literacy acquisition. Similarly, Nielsen et al. (2016) propound the use of Signed Exact English (SEE) in order to facilitate the necessary morphological awareness through devising signs for specific morphemes. In

both of these instances, researchers observe practitioners adopting similar bridging interventions as those used by DHH mothers.

What is evident, therefore, is that the literature indicates a necessity for teaching explicit linguistic features in order that DHH pupils have a clear understanding of language prior to learning to read. Both Twitchell et al. (2015) and Marschark & Lee (2014) recognise the benefit of having early access to language in the home – signed, spoken or simultaneous communication – in order to provide the linguistic knowledge necessary for literacy development. Indeed, as Twitchell et al. (2015) explain, previous research has suggested that access to signed language provides a basis for the development of reading simply in that it is a language, rather than it sharing any elements with the written word. Thus the implication would be that linguistic awareness of some sort is necessary for DHH children to achieve in literacy.

Certainly, given the complex linguistic backgrounds of DHH children, regardless of whether they are DoD or DoH, the evidence seems to indicate a necessity to ensure their linguistic awareness. Whilst DoD parents appear to facilitate this using bridging techniques between signed and written language, what would seem clear is that this is not enough to ensure that all DHH children develop literacy at the same rate as their hearing peers. Firstly, these bridging techniques and linguistic links should be available for that majority of DHH children born to hearing parents through the provision of adequate signed linguistic support for said parents. Further, the education of all DHH children should recognise their d/Deafness and thus utilise standardised early interventions aimed at improving linguistic awareness in all modalities. In this way, both home and educational environments could work together to ensure the literacy development and overall achievement of DHH pupils.

Mathematics

Whilst much of the literature reviewed focuses on literacy and reading, there has been some exploration of the impact that d/Deafness may have on mathematical success. Marschark et al. (2013) explain that mathematics is an area in which DHH students traditionally underperform. It can be argued that this is as a result of DHH students' lack of understanding of technical vocabulary or a lack of availability signs

corresponding with particular mathematical lexicon (Vesel & Robillard, 2013). Equally, Vesel & Robillard (2013) claim that this could be compounded by a lack of teacher awareness of signs pertaining to specific topics. Vesel & Robillard (2013) champion the use of a Signing Maths Dictionary (SMD) with DHH students in order to promote independence and ensure use of standardised signs across educational establishments, thus promoting teacher confidence within the signed mathematical lexicon.

Equally, it was suggested by Lange et al. (2013), that mathematics performance for DHH students in an ASL-English bimodal/bilingual programme demonstrated higher levels than literacy outcomes for the same cohort of pupils over four years. This could suggest that the use of a signed language in conjunction with spoken English instruction could have an impact on the mathematical success of DHH students.

Marschark et al. (2013) also highlighted that visual-spatial skills also correlated with mathematical performance and suggested that use of diagrams may support DHH pupils to utilise visual-spatial awareness to solve mathematical problems. Whilst all of these interventions appear to be quite different, what is clear is that concurrent use of signed and spoken language (whether through an interactive resource or through teacher-talk) would appear to support mathematical success, as does differentiated material such as the inclusion of diagrams. All of this implies the necessity that teachers must recognise and meet the needs of their DHH learners in order to ensure mathematical achievement.

In conclusion, the research within this field also points towards a necessity for education to recognise d/Deafness and to provide both signed and spoken support for DHH students in order for them to achieve. According to the literature, it would seem that achievement in mathematics requires linguistic ability in so far as students must understand tasks set. Yet when understanding has been reached, mathematical achievement would appear to outperform achievement in literacy amongst DHH pupils, thus further linguistic ability may not be necessary in this subject. This, therefore, would appear to call for DHH education to utilise all available resources – sign language (to include standardised mathematical lexicon); technology and diagrams – in order to maximise the teacher and pupil awareness of terminology and mathematical concepts.

Cognitive Skills

In recognising the cognitive needs and abilities of DHH learners, the literature would appear to make certain key points. Firstly, it would appear that DHH and hearing students exhibit different cognitive strengths, regardless of their language modality (Marschark, et al., 2015). Even when considering visual-spatial tasks as opposed to specifically language-based exercises, the cognitive differences between DHH and hearing students appear to differ (Marschark, et al., 2013). Yet according to Marschark et al. (2016), visual-spatial tasks are not solely visual and spatial. Rather, there are higher cognitive skills in place which are, in fact, linked with linguistic ability. This appears to be evidenced in the findings of Marschark's earlier article (Marschark, et al., 2015) in which apparently language-independent tasks showed advantages in those participants with higher skills in signed language. What this suggests is that, whilst the cognitive and academic challenges faced by DHH learners are not necessarily the cause (or the consequence) of their complex linguistic background, they are in reality inextricably linked with it (Marschark, et al., 2015). In terms of educational implications therefore, it can be suggested that assuming DHH students have cognitive strengths in one specific area (for example visual-spatial awareness), is actually a failure to recognise their differing cognitive abilities (Marschark, et al., 2013). Equally, it is a failure to recognise that different cognitive skills may benefit different academic areas in order to support achievement (Marschark, et al., 2013).

Marschark et al. (2013) also explain that it is important that teachers recognise the different cognitive strengths and needs of DHH and hearing pupils – of which Teachers of the Deaf (ToD) are more likely to be aware. The conclusion which can be drawn therefore, is that the requirement – and challenge – for educators is to recognise cognitive differences and ensure the appropriate mix of methodologies and modalities to ensure the development of world knowledge and the ability to utilise this (Marschark, et al., 2015).

Evidently, unlike the other areas discussed thus far, cognitive skills and their significance for DHH education would appear to be an area in which there is little difference between DHH pupils and their hearing peers. Whereas with literacy and

mathematics, strategies specifically targeting DHH children can be put in place, the key message within the research into the cognitive skills of DHH children would appear to be that educators should – as with hearing pupils – recognise that all DHH children have unique cognitive skills and abilities and thus should plan for this when considering teaching and learning.

SOCIAL-EMOTIONAL IMPLICATIONS

In addition to the academic achievement of DHH students when discussing inclusion, it is also necessary to consider their social and emotional wellbeing – how they perceive themselves and their d/Deaf identity, as well as how they interact with each other and with hearing peers. Whilst this is arguably an intrinsic element of inclusive education, the literature reviewed does not appear to place a great deal of emphasis on social-emotional development, with some exceptions (Yiu & Tang, 2014; Martin et al., 2014; Marschark et al., 2015).

Yiu & Tang (2014) explore the bimodal, bilingual education within a co-enrolment school in Hong Kong (the private Sign Bilingualism and Co-enrolment [SLCO] Programme) and examine both the extent of DHH pupils' integration with hearing peers and the need for their bicultural identity to cement their social-emotional development. They argue that many factors impact on the social integration of DHH students in mainstream schools – although as the culture of education shifts more in favour of mainstreaming, those factors too will change and evolve (Yiu & Tang, 2014). Further, given the propensity of DHH children who are born to hearing parents, and the general educational focus on the oral-aural modality, DHH children initially tend to form their identity in line with hearing culture and aim to "fit-in" (Yiu & Tang, 2014, p. 345). However, their findings imply that in a co-enrolment, bimodal, bilingual setting, both hearing and DHH students acquire both spoken and signed language proficiency and use both common languages for social interaction, thus removing communication barriers (Yiu & Tang, 2014). This correlates with the findings of Martin et al. (2014), who explain that in bimodal bilingual settings, pupils adapt effectively and can manage the social-emotional demands of the establishment, thus implying a link between bilingualism and the social-emotional development of DHH pupils.

Indeed, within the SLCO Programme, it became clear that social acceptance was not, as in mainstream, predicated on spoken language ability; but rather sign language ability and positive attitudes towards d/Deafness (Yiu & Tang, 2014). Further, the employment of DHH teachers, as well as a large cohort of DHH pupils, not only appeared to aid integration with hearing peers – through a greater understanding of Deaf history and culture on the part of the hearing peers – but also served to build an identity for DHH students in terms of bicultural acceptance (Yiu & Tang, 2014). In addition to building social integration, this also ensures that the DHH students achieved self-actualisation of their Deaf identity, a trait which has been recognised in previous studies for its importance in terms of emotional wellbeing (Yiu & Tang, 2014).

In summary, Yiu & Tang (2014) discovered that in a bimodal, bilingual, co-enrolment setting, early access to both signed and spoken language (for both DHH and hearing students) bound a sense of identity and togetherness in all pupils. It further demonstrated positive social outcomes predicated in skills based on two common languages, rather than solely in the oral-aural communication commonly found in mainstream settings. Thus it would appear that acquisition of language skills – regardless of modality – at age-appropriate times also supports the development of social-emotional skills (Marschark, et al., 2015).

What would appear to be essential for the social-emotional development of DHH pupils therefore would be the notion of their identity – whether they wish to develop that identity in relation to the Deaf community or the hearing community. Bimodal bilingual education therefore would seem to be an ideal opportunity to provide DHH pupils with the skills and abilities to develop their own identities whilst interacting with both DHH and hearing peers. Further, it develops skills and awareness of hearing pupils and thus allows for richer and more meaningful social integration. Within the context of Scottish education, therefore, it would appear that bimodal bilingual education offers both hearing and DHH pupils real development of their health and wellbeing with regards to the SHANARRI indicators and thus a genuine opportunity to achieve both socially and academically.

COMPLICATIONS SURROUNDING DHH EDUCATION

One of the over-arching themes within the literature reviewed is the complexity of ensuring the inclusion and achievement of DHH learners. Various factors, it would appear, contribute to this complexity adding complications or barriers to the inclusion and achievement of DHH learners.

Socio-Economic Status

Twitchell et al. (2015) conducted a survey examining the effects of socio-economic status (SES) on the linguistic outcomes of DHH bilingual children. Whilst they recognised that in earlier studies based on both monolingual and bilingual hearing children, higher-SES related to more positive language and literacy outcomes in language 1 (L1) and L1 & L2 respectively, they discovered that the impact of SES on DHH children was somewhat more complex.

It can be argued that ASL is the equivalent of a minority language and, in that regard, is not socially esteemed (Twitchell, et al., 2015). Therefore, whilst in general, DoD children can be found in middle- or working-SES (although not always); DoH children can be found at all socio-economic levels (Twitchell, et al., 2015). In comparison with other minority languages therefore, those DHH children in DoD families which traditionally have lower-SES, tend to have better L1 outcomes than in DoH families (Twitchell, et al., 2015). However, sign bilingual DoH children often have parents who are attempting to learn sign language (often alongside their DHH child) and therefore SES can still be indicative of literacy and linguistic skills (Twitchell, et al., 2015).

In fact, access to language and literacy rich environments associated with high-SES families still enable DHH children to develop language and literacy skills and thus are still beneficial to DHH children (Twitchell, et al., 2015). Similarly, an ability to afford a private education and the benefits and supports that this provides in the inclusion and achievement of DHH children is another advantage available to high-SES families (Walker & Tomblin, 2014).

In summary, although SES is a complex issue for DHH individuals, in that their fluency in a minority language such as ASL may suggest lower-SES (and thus may impact on their future inclusion or achievement), SES can still be a beneficial factor in ensuring optimal conditions for language development. If an awareness of ASL and high-SES work together, they can offer mutual support to develop literacy in DHH children (Twitchell, et al., 2015). Thus not only does SES potentially impact linguistic development in DHH children; it too can be impacted by the linguistic choices and strengths of these DHH individuals. SES naturally impacts the language and achievement of everyone, and thus it is important to take it into consideration in an educational context. However for DoD pupils, the impact SES has on their development is almost the converse of the norm in that their SES is generally low and yet their linguistic background tends to be very rich, resulting in positive L1 & L2 development; contrasting with hearing peers whose L1 (& L2 for bilingual children) outcomes tend to be negatively affected by SES. In educational terms therefore, whilst it is important to consider the impact of SES on pupil achievement, it is equally as important to consider other factors.

Learning Styles

The assumption that DHH learners prefer a visual learning style as a result of an increased reliance on visual modalities rather than audition (Marschark et al., 2013; Marschark et al., 2016) is one for which there is no real evidence (Marschark, et al., 2013). Whilst DHH individuals demonstrate some visual-spatial advantages over hearing individuals, there is no explicit relevance to academic achievement (Marschark, et al., 2013). Additionally, whilst deaf native signers demonstrate a better visual-spatial working memory than hearing peers, there is no evidence to suggest that this is true of the other 95% of DHH individuals (Marschark, et al., 2013). Even within the DHH population, variations in hearing thresholds (through differing levels of hearing loss, use of hearing aids or implantation with CIs) as well as differences in visual acuity, mean that DHH individuals' reliance on visual information also varies widely (Marschark, et al., 2016). Linguistically, the idea that DHH children rely on the visual modality when using sign language is also problematic, as sign language – like reading – is a verbal skill, even if it relies on vision rather than voice (Marschark, et al., 2013). In fact, visual

learning and verbal learning are not mutually exclusive skills – pupils can be adept in both visual and verbal skills (Marschark, et al., 2013).

In summary, whilst DHH individuals do use vision in order to interpret language and their surroundings, they are no more likely to be visual learners than their hearing peers. Even within the visual learning style itself, Marschark et al. (2013) explain that there are two different visual learning styles rendering it an unhelpful label. For these reasons, the assumption that DHH children are visual learners is one which does not support their inclusion or success. The difficulty for educators therefore, is the assumption that DHH students are visual learners and thus what is evident is that teachers of DHH pupils, as with hearing pupils, should address a variety of learning styles within activities. In this way, the needs of all pupils should be addressed.

Lack of homogeneity

The reality is that DHH learners are not an homogenous group – and it is this heterogeneity which makes research complex and the literature often confusing and contradictory (Marschark, et al., 2015). Many DHH learners come to school with varied and complex linguistic backgrounds and it is important to remember that many will not be fluent in the language used within the classroom, regardless of what that language is (Marschark & Lee, 2014). In order for DHH students to be successful – especially in a mainstream environment with hearing peers and a hearing teacher – the classroom interactions must be linguistically accessible and must take into consideration the knowledge and learning styles of DHH pupils (Marschark & Lee, 2014). As Knoors (2016) explains, it is important to remember that educators should not make assumptions about their DHH learners, such as: that CIs lead to successful classroom interactions; or that a single language or modality will enhance the experiences of all DHH learners. Indeed, whatever route is taken for DHH learners, it does not guarantee achievement for all DHH individuals, nor does it guarantee achievement for them all to the same degree (Knoors, 2016). Undeniably, whilst the introduction of sign language within classrooms and the advent of early cochlear implantation to improve hearing and speech have both offered DHH children far greater opportunities, neither has had such success as to allow professionals to discount the other (Marschark, et al., 2015).

It becomes clear from the literature reviewed, that the argument tends towards greater flexibility in interventions according to the needs of the individual child (Martin, et al., 2014) rather than a "one-size-fits-all model" (Lange, et al., 2013, p. 543). Assuming all learners – whether DHH or not; signers or not – will benefit from one single method of teaching is actually more likely to be detrimental in terms of their overall success, rather than helpful (Marschark, et al., 2016). As Lange et al. (2013) say: "research demonstrates a variety of paths for a DHH student to develop academically" (p. 543). Further, lack of training and lack of regular professional standards when considering early interventions to support DHH children (particularly from 0-3 years old, a time key to the effective acquisition of language) causes real potential issues for DHH students (Guardino & Cannon, 2016). Recommendations to ensure that the needs of all DHH learners are met include ensuring that they have role models, like themselves, who are successful. It is also recommended that teachers are prepared for the diversity of students whom they may teach; and that families are supported to provide language-rich environments to sustain the development of linguistic skills (Guardino & Cannon, 2016). Even within these various approaches, there should be scope for further flexibility:

> "Families with a newly diagnosed child may be counselled that early decisions about communication approaches are not fixed for life. Instead it may be more appropriate to introduce signed communication in combination with spoken language, in order to lay a foundation for later communication development" (Walker & Tomblin, 2014, p. 147).

In conclusion, therefore, the research would indicate the need for a flexibility of approaches to communication mode and intervention strategies – which recognise this lack of homogeneity – in order to maximise the linguistic development, academic success and inclusion of DHH children.

SUGGESTED INTERVENTIONS

Throughout the literature reviewed, various interventions are discussed and the impact of said interventions evaluated. As previously highlighted, there does not appear to be one single intervention which can be adopted for all DHH learners.

Cochlear Implantation

Recently, there has been an increase in the number of early cochlear implants (Ormel & Giezen, 2014) which has led to real change in the education of DHH students (Walker & Tomblin, 2014). Whilst CIs are commonly used to facilitate hearing and speech production (Knoors, 2016) they must still be treated with some caution. In fact, CIs can only offer partial sound (Ormel & Giezen, 2014) and, as a result, spoken language post-implantation often still falls short of that of hearing peers (Ormel & Giezen, 2014). Granted, the perception of hearing parents, that CIs allow for increased exposure to early language does appear to lower parental anxiety and increase natural communication in DoH families, according to earlier research (Martin, et al., 2014). Yet the fact remains that this advent in CI usage has impacted on the use of sign language with DHH children (Ormel & Giezen, 2014). Indeed, attitudes towards Oral Communication (OC) compared with Total Communication (TC) programmes have seen a dramatic change (Walker & Tomblin, 2014) and sign language is now being considered by many as a support system to bolster spoken language development, rather than as a language with developmental benefits for DHH children (Ormel & Giezen, 2014).

In conclusion, whilst CIs can support the hearing and speech development of DHH children, they do not necessarily bring them to an equal hearing status as their hearing peers. Consequently, there is much potential that DHH children may still miss rich linguistic experiences if oral-aural communication remains the sole communicative focus, as commonly tends to be the case when CIs are involved, therefore the research would suggest that it is important to use signed language in conjunction with CIs.

Virtual Reality

Recent technological advances have seen introductions in sign language technology (Vesel & Robillard, 2013; Zirzow, 2015). Whilst both Vesel & Robillard (2013) and Zirzow (2015) examine the role of signing avatars in the education of DHH students, it is worthy of note that Vesel & Robillard conduct a case study in order to explore the efficacy of one specific piece of technology; whilst Zirzow briefly explores literature pertaining to a number of different options.

When considering the impact of the use of a Signing Math Dictionary (SMD), Vesel & Robillard (2013) highlight that it has been designed according to the Universal Design for Learning Framework and that it provides learners with a variety of ways in which to acquire knowledge; a number of alternatives to demonstrate said knowledge; and various options to improve motivation and challenge for learners. They argue that the signing exhibited has been researched in some detail to ensure accuracy surrounding the various topics (Vesel & Robillard, 2013). The study concludes that access to mathematical signs through the SMD appears to make a great difference to DHH learners (Vesel & Robillard, 2013).

Zirzow (2015) explains that whilst utilising these resources, the signing avatar must have the ability to move between finger-spelling and whole word signing; and must differentiate facial expressions and aspects of body language in order to enable the user to recognise the subtleties of signing which form its necessary language elements. However, she does recognise that this form of technology can play a vital role in assisting the success of DHH students, through the provision of a visual language (Zirzow, 2015). She does, however, exert a note of caution, in that, not all students will be able to access or utilise such supports effectively without explicit teaching, help and practice (Zirzow, 2015).

In conclusion, therefore, there have been various technological advances which could be used to provide positive interventions, alongside other opportunities, so as to provide DHH students with clear support in order to achieve (Guardino & Cannon, 2016). Whilst there are, naturally, considerations surrounding access to and training in these technologies, they, nevertheless, would appear to be another element which can – relatively easily – be implemented in order to provide DHH pupils with the most comprehensive support to achieve. Even today, there is real potential within current virtual reality, avatar, voice recognition and artificial intelligence technologies to develop avatars capable of translating spoken word into sign. If appropriate experts could be utilised to explore the development of such technologies, this could see a step-change in the future of DHH education.

Bimodal Bilingual Education

The major focus of the interventions suggested within the articles reviewed tended towards an examination of sign bilingualism. Naturally, DoD children are far more likely than DoH to be sign bilingual, yet they make up only 5% of the DHH population (Marschark et al., 2013; Yiu & Tang, 2014; Twitchell et al., 2015). Given that the majority of DHH children are born into hearing families, the majority of parents do not know sign language when their DHH child is born (Berke, 2013) and thus many DHH children develop less optimal linguistic skills as a result of this lack of exposure to language, since age of acquisition impacts a child's ability and fluency (Martin, et al., 2014).Yet in a longitudinal survey carried out by Lange et al. (2013), they discovered that parental hearing status was not actually a factor in terms of the success of DHH pupils in a sign bilingual education programme, but rather that bilingualism in school could be seen to mitigate the effects of late exposure to language, thus implying benefits of sign bilingual education.

Internationally, there is much variety in access to bimodal bilingual programmes: in many countries, such as the UK and the USA, bilingual education has historically only been one options amongst many; yet in other countries such as Scandinavia and Spain, it has traditionally been the primary focus of DHH education (Marschark & Lee, 2014). Sign bilingual education programmes tend to date back to the 1980s and 1990s (Lange et al., 2013; Martin et al., 2014; Marschark & Lee, 2014) although many countries – including the UK – have seen a decrease in popularity with the advent of early cochlear implantation and a concern that too much emphasis is placed on signed and written language rather than spoken (Marschark & Lee, 2014). Consequently, many DHH students are now being taught in mainstream classrooms alongside hearing peers (Knoors, 2016).

There are a number of different bilingual educational models offering different teaching methodologies to DHH pupils. For instance, the Total Communication method outlined by Walker and Tomblin (2014) is said to combine auditory, manual and vocal communication to promote effective communication for DHH learners. Nielsen et al. (2016) describe an alternative model using Signed Standard English (SSE), the rationale with this being that Standard English is the national language of the USA and thus SSE

supports greater access to academic content for DHH pupils, thus allowing them a better chance of progression. Lange et al. (2013) also describe a sign bilingual programme in the USA in which DHH children are taught in ASL/English with their academic and their linguistic progress being continually monitored. Finally, Yiu & Tang (2014) explore a recent attempt to incorporate bilingualism into mainstream education in Hong Kong, rather than being confined solely to the special education system by examining a co-enrolment programme similar to that found in Madrid (Yiu & Tang, 2014; Martin et al., 2014). Whilst the Hong Kong programme is part of the private system (Yiu & Tang, 2014), the co-enrolment programmes found in Spain are directed by government policy and driven by schools and parents as a result of formal support or frameworks (Martin, et al., 2014). Co-enrolment involves DHH and hearing students studying in the same class and being taught concurrently by a hearing teacher and a teacher fluent in sign language (Yiu & Tang, 2014). They involve large cohorts of DHH children (ideally in equal numbers to hearing pupils); a dual language input for all students who learn co-operatively and thus embody an inclusive philosophy (Yiu & Tang, 2014).

The literature reviewed tended to focus on a number of benefits of this form of educational instruction, for example Lange et al. (2013) explain that, although DHH students were still achieving somewhat below the national average, they nevertheless outperformed DHH peers who were not involved in sign bilingual education; and even broke through the 'plateau' normally witnessed in the achievement of DHH pupils, thus supporting the efficacy of this model as an effective medium for educating DHH learners (Lange, et al., 2013). Equally, Yiu & Tang (2014) explain that they found that co-enrolment benefits both DHH and hearing students, developing and fostering mutual understanding and acceptance, as well as building bilingualism. They argue that, given the large population of bilinguals globally, co-enrolment not only preserves signed languages, but also develops DHH individuals' identity as part of the bilingual majority (Yiu & Tang, 2014). More generally, evidence would imply that the relationship between sign language ability and measures of reading are equivalent to a demonstration of the benefits of sign bilingual education (Marschark & Lee, 2014). Certainly, Ormel & Giezen (2014) mention a previous study in which ASL interpreters were assessed at the beginning of their interpreter course and then again two years later,

demonstrating an improvement in various areas of cognitive skill, thus also advocating the benefits of sign bilingualism.

In terms of linguistic development, bimodal bilingualism can be seen to place a lower demand on language control than unimodal bilingualism, given that signs and speech can be produced concurrently (Ormel & Giezen, 2014) implying a greater case of cross-language interaction and development. Further, assuming similarities between unimodal and bimodal bilingual development, although individual spoken and sign vocabularies may be smaller than for monolingual peers, when considered together, the total bilingual vocabulary is likely to be equal to or larger than that of monolinguals (Ormel & Giezen, 2014). Again, the implication here is that bimodal bilingualism offers benefits in terms of linguistic development. Indeed, recent research indicates that sign language can, in fact, partner with spoken language to support the linguistic, cognitive and psychosocial development of DHH children (Yiu & Tang, 2014). Researchers explain that it is beneficial for DHH children to acquire early sign language in order to maximise their linguistic development (Ormel & Giezen, 2014) given that sign language is arguably the only language which is fully accessible to DHH children with or without CIs (Ormel & Giezen, 2014). In Spain, researchers suggest that early exposure to LSE (Lengua de Signos Española) whilst waiting for cochlear implantation to take hold has led to positive cognitive and linguistic development (Martin, et al., 2014) whilst other researchers argue that having access to two modalities and languages benefits CI users (Marschark & Lee, 2014). There is also an argument that sign language can be acquired earlier and more easily than spoken language and thus facilitates development of further skills (Marschark & Lee, 2014). Certainly, early studies of CI users exposed to speech with signed support show positive performance in speech-related domains (Walker & Tomblin, 2014). Evidently, therefore, the evidence would suggest the need for flexibility of choices for DHH individuals with or without cochlear implants (Martin, et al., 2014).

Regardless of the positive evidence, there are still some difficulties regarding sign bilingualism. As demonstrated through the decrease in sign bilingual programmes in Scandinavia, there can be a tendency for spoken language to be marginalised in favour of signed and written modes (Marschark & Lee, 2014). Equally, whilst attainment for

DHH bilinguals did increase in Sweden, so did attainment for their hearing peers thus the inequality remained (Marschark & Lee, 2014). Certainly, research would also appear to suggest that, whilst DHH attainment does increase in bilingual programmes, those DHH students still do not perform at the same levels as their hearing peers (Walker & Tomblin, 2014). Critically, whilst much discussion considers the linguistic complexity of DHH students (Lange et al., 2013; Martin et al., 2014; Marschark & Lee, 2014; Walker & Tomblin, 2014; Marschark et al., 2015; Guardino & Cannon, 2016; Nielsen et al., 2016; Knoors, 2016), it is also important to note the diverse and complex linguistic backgrounds of the ToD or sign-fluent teachers working within these bilingual programmes (Knoors, 2016). However, each language or modality utilised in education – particularly in bimodal bilingual education – displays its own challenges dependent on the setting, language and user involved (Knoors, 2016).

In conclusion, there are challenges which must be overcome when considering bimodal bilingual education programmes. The results of such programmes do not necessarily bring the inclusion of DHH pupils in line with their hearing peers in terms of linguistic development or academic success. However, there does appear to be a positive correlation between the success of DHH students and bilingual education in comparison to those educated in a mainstream oral-aural setting. Certainly, exposure to early sign language – even for those with cochlear implants – appears to have benefits in both academic and social-emotional areas. Further, it can be argued that sign bilingual education can actually improve the linguistic development of those DHH children born to hearing parents. Whilst there are many bimodal bilingual educational methodologies, co-enrolment, as demonstrated in Spain and in Hong Kong, appears to benefit both DHH and hearing students both in academic outcomes and in social-emotional success.

CONCLUSION

Much of the literature reviewed emphasises a lack of empirical, evidence-based research (Lange et al., 2013; Vesel & Robillard, 2013; Marschark & Lee, 2014; Walker & Tomblin, 2014; Marschark et al., 2015; Guardino & Cannon, 2016; Nielsen et al., 2016)

as a result of the entrenched emotional and philosophical attitudes to DHH education (Lange et al., 2013; Walker & Tomblin, 2014) as mentioned in the rationale of this review. Additionally, what research there is available is often confusing and contradictory as a result of the lack of homogeneity of DHH learners (Marschark, et al., 2015). It is also worthy of note, that a majority of the empirical studies reviewed in this dissertation took place in the USA (Berke, 2013; Lange et al., 2013; Marschark et al., 2013; Vesel & Robillard, 2013; Bennett et al., 2014; Twitchell et al., 2015; Nielsen et al., 2016; Marschark et al., 2016) and none of the literature reviewed focuses on a UK context. Yet it remains clear that there can be some conclusions drawn from this systematic review of the available literature.

Firstly, it is evident that linguistic awareness – both spoken and signed – benefits literacy development in DHH students. This, in turn, underpins academic achievement, thus promoting the wellbeing and inclusion of this group of learners. Similarly, visual aids, ostensibly in the form of signed support, enhance the success of DHH learners in mathematics. Further, the social-emotional development of DHH learners can be supported through the development of their bicultural identity in addition to early language acquisition (again, both spoken and signed). Clearly socio-economic status should be considered as it would be with all learners, yet is more complex in its interaction with the language development of DHH learners than with their hearing peers. Although SES can impact the linguistic ability of DHH children; it can also be impacted by their DHH status. Language acquisition and development therefore, is hugely significant in considering the inclusion of DHH learners.

What is particularly evident is that DHH children are not an homogenous group and thus require a flexibility of approach in which teachers recognise and plan for their cognitive differences, whilst bearing in mind that, despite their dependence on their sense of sight, DHH pupils are not necessarily visual learners. Thus recognition of cognitive strengths and abilities can also benefit the inclusion and achievement of DHH learners.

Conclusions can also be drawn regarding early cochlear implantation, which, although beneficial to the hearing and speech of DHH children, does not make them equal to

their hearing peers. In fact, use of CIs can have a negative impact on the use of signed languages. Yet through studies into bimodal bilingual education programmes, it can be argued that simultaneous use of CIs plus exposure to signed language can aid the linguistic development of DHH students, which has been proven to bolster success in literacy, mathematics and cognition. Further, bimodal bilingual education in a co-enrolment model can also benefit the psychosocial development of DHH children, through explicit inclusion with hearing peers. Again, therefore, linguistically-rich environments and flexibility of approach can be seen to have a positive effect on the inclusion of DHH students.

Certainly, the development and introduction of signing avatars has the potential to transform mainstream education into bimodal bilingual education with relative ease. Utilising technology in which a signing avatar can be displayed on a Smartboard in conjunction with other visual cues could transform the education of DHH pupils – and allow hearing peers to learn sign language by osmosis. Not only could this improve the education of DHH pupils; it could also positively impact their hearing peers in raising their awareness and acceptance of those with differing abilities. Further, it could positively impact the awareness and abilities of mainstream teachers working with DHH pupils.

FUTURE IMPLICATIONS

The first noteworthy implication of this research indicates that, given the importance of language development for children aged 0-3 years, early intervention is crucial in supporting the inclusion and achievement of DHH children. There has been some movement towards early cochlear implantation in DHH children, yet whilst this is of some benefit, the research would imply that using sign language alongside CIs would be of more value linguistically. Thus one significant implication would appear to be the need to educate (hearing) parents regarding the various ways in which they can support their DHH child and offer them the means to learn sign language in order to best do so. This therefore, has implications for service providers other than education and thus a

multi-agency approach in order to maximise the linguistic development, inclusion and achievement of DHH pupils would seem to be essential.

The implications of these findings would further suggest that a positive way forward for DHH education would be to develop bimodal bilingual education programmes which harness technology and virtual reality to support DHH pupils (with and without CIs). In this way, bimodal linguistic development and recognition of their cognitive differences should aid their academic development and social-emotional success through flexibility of approaches, thus improving their levels of inclusion. There is, however, a real and pressing need for further and more detailed empirical research into the education of DHH pupils in all areas and through all modalities, particularly in a UK context.

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Appendix 1: Articles from Library Catalogue Search

Article	DHH Education implied	Sign Language mentioned / implied	Inclusion mentioned / implied	Focus on other relevant areas	Multilingual other than sign language	Subject specific	Too many variables?	Include in review?
Sociocultural and academic considerations for school-aged/Deaf and hard-of-hearing multilingual learners: A case study of a Deaf Latina	Yes	No	Yes	Yes	Yes	No	Yes	No
d/Deaf and Hard of Hearing Learners	Yes	Yes	No	Yes	Varied	No	Yes	No
DML, DLL, ELL, EL, ESL . . . or Culturally and Linguistically Diverse								
Deafness and Diversity: Reflections and directions	Yes	No	Yes	Yes	?	No	No	Yes
Reading among diverse DHH learners	Yes	No	No	No	?	Yes	No	No

Are We Hammering Square Pegs Into Round Holes?: An Investigation of the Meta-Analyses of Reading Research With Students Who Are d/Deaf or Hard of Hearing and Students Who Are Hearing	Yes	No	Yes	No	No	Yes	Yes	No
Case studies of multilingual /multicultural deaf Asian adults	No	No	No	Yes	Yes	No	Yes	No
Predictors of English reading comprehension for children who are d/Deaf or HH	Yes	No	No	Yes	No	Yes	No	No
Explicitly teaching English through the air to students who are deaf or hard of hearing	Yes	Yes	Yes	Yes	No	No	No	Yes
Theory research and practice for students who are deaf or HH with disabilities	Yes	No	No	Yes	No	No	Yes	No
The qualitative similarity hypothesis	No	No	No	No	No	No	No	No

The English Language and Reading achievement of a cohort of Deaf students speaking and signing standard English	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Assessment accommodations on tests of academic achievement for DHH students	Yes	No	No	Yes	No	No	No	No
Written forms of signed languages: A route to literacy for Deaf Learners?	Yes	Yes	Yes	Yes	No	Yes	No	Yes
DHH College and High School Students perceptions of speech-to-text and interpreting / note taking services and motivation	Yes	No – alternative intervention	Yes	Yes	No	No	No	Yes
The design and teaching of multimedia for teaching arithmetic to deaf learners	Yes	No	No	Yes	No	Yes	No	No
Don't assume Deaf students are visual learners	Yes	Yes	Yes	Yes	No	No	No	Yes

In praise of doubt and systematic enquiry: Conclusion	No	No	No	No	No	No	No	No
The Development of Antonym Knowledge in American Sign Language (ASL) and Its Relationship to Reading Comprehension in English	Yes	Yes	No	Yes	No	Yes	No	No
The impact of input quality on early sign development in native and non-native language learners	Yes	Yes	No	Yes	No	No	No	Yes
Audism and racism: the hidden curriculum impacting black D/deaf college students in the classroom	Yes	No	Yes	Yes	No	No	Yes	No
Effects of SES on Literacy development of Deaf signing bilinguals	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Assessment and Reading Paradigms: A response to John Luckner	No	No	No	No	No	Yes	No	No

Thinking for Writing: A prolegomenon on Writing Signed Languages	No	Yes	No	Yes	No	Yes	No	No
Professionals guidance about spoken language multilingualism and spoken language choice for children with hearing loss	Yes	Yes plus alternative interventions	Yes	Yes	Yes	No	No	Yes
A dialogue on the multiple facets of sustainability	No	No	No	No	No	No	No	No
Grammar structures and DHH Students: A review of past performance and a report of new findings	Yes	No	No	Yes	No	Yes	No	No
Deaf students' knowledge of subtle lexical properties of transitive and intransitive English verbs	Yes	No	No	Yes	No	Yes	No	No
A preliminary study on interpreting for emergent signers	Yes	Yes	Yes	No	No	No	No	Yes
In Praise of doubt and systematic enquiry	No	No	No	No	No	No	No	No

Teaching Maths vocabulary with an interactive Maths signing dictionary	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Signing avatars: using virtual reality to support students with hearing loss	Yes	Yes	Yes	Yes	No	No	No	Yes
Thoughts about a possible bridge from ASL to literacy	No	Yes	No	No	No	Yes	No	No
Comparison of Students' achievement: Deaf, Learning disabled and Deaf with a learning disability	Yes	No	No	Yes	No	No	Yes	No
Undergraduate research involving DHH students in interdisciplinary science projects	Yes	No	No	Yes	No	Yes	No	No
Research on Deafness	No	No	No	No	No	No	No	No

List of Papers

Appendix 2: Articles from Bibliography Review One

Article	DHH Education implied	Sign Language mentioned / implied	Inclusion mentioned / implied	Focus on other areas	Multiling other than sign language	Subject specific	Too many variables ?	Available	Peer review?	Education	Include in review ?
Critical Needs of students who are deaf or hard of hearing	Yes	No	Yes	No	No	No	No	No	n/a	n/a	No
Communication and language in learners who are deaf and hard of hearing with disabilities	Yes	Yes	Yes	No	No	No	Yes	n/a	n/a	n/a	No
Single-case design research: Building the evidence base in the field of education of deaf and hard of hearing students	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
From the margins to the spotlight: Diverse deaf and hard of hearing student populations and standardised assessment accessibility	Yes	No	Yes	No	?	No	Yes	n/a	n/a	n/a	No

'Part of our world': influences on caregiver decisions about communication choices for children with hearing loss	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No
Speech, sign or multilingualism for children with hearing loss: quantitative insights into caregivers' decision making	Yes	Yes	Yes	Yes	No	No	No	No	n/a	n/a	No
Literacy and deaf and hard of hearing students in *Educating deaf learners: Creating a global evidence base*	Yes	No	No	No	No	Yes	No	n/a	n/a	n/a	No

Regional and national summary report of data from the 2011-2012 Annual Survey of Deaf and hard of hearing children and youth	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
Evaluation teachers' preparedness to work with students who are deaf and hard of hearing with disabilities	Yes	No	Yes	Yes	No	No	Yes	n/a	n/a	n/a	No
Theory, research and practice for students who are deaf and hard of hearing with disabilities: Addressing the challenges from birth to post-secondary education	Yes	No	Yes	Yes	No	Yes	Yes	n/a	n/a	n/a	No

Survey of Spanish parents of children who are Deaf or hard of hearing: Decision making factors associated with communication modality and bilingualism	Yes	Yes	Yes	Yes	Yes	No	Yes	n/a	n/a	n/a	No
Bilingual skills of Deaf / hard of hearing children from Spain	Yes	No	Yes	Yes	Yes	No	Yes	n/a	n/a	n/a	No
Deafness and Diversity: Early Intervention	Yes	? Interventions	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Transition services for DHH adolescents and young adults with disabilities: Challenges and theoretical frameworks	No	No	Yes	Yes	No	No	Yes	n/a	n/a	n/a	No

Alignment of single-case design (SCD) research with individuals who are Deaf or hard of hearing with the What Works Clearinghouse standards for SCD research	No	No	No	Yes	No	No	No	n/a	n/a	n/a	No
The communication needs of people with hearing loss: Exploring the views of adults, young people and providers of communication services	No	Yes	Yes	Yes	No	No	No	Yes	No	n/a	No
CRIDE Report (s)	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	n/a	No
Teaching writing: Principles into practice in *Promoting language and literacy in children who are deaf or hard of hearing*	Yes	No	No	Yes	No	Yes	No	n/a	n/a	n/a	No

Rethinking total Communication: Looking back moving forward in *The Oxford Handbook of Deaf Studies in language: Research, policy and practice*	Yes	Yes – plus alternatives	Yes	Yes	No	No	No	Yes	Book Chapter	Yes	Yes
Is reading different for deaf individuals?	Yes?	No	Yes?	No	No	Yes	No	n/a	n/a	n/a	No
Early literacy development in deaf children	Yes	No	Yes	No	No	Yes	No	n/a	n/a	n/a	No
Deaf students and the qualitative similarity hypothesis: Understanding language and literacy development	Yes	Yes	Yes	Yes	No	No	Yes	Yes – entire book	n/a	n/a	No

Executive functions and behavioural problems in deaf and hard of hearing students at general and special schools	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
Language use in the classroom: Accommodating the needs of diverse DHH learners in *Diversity in deaf education*	Yes	Yes	Yes	No	No	No	No	Yes	Book Chapter	Yes	Yes
Neurocognitive risk in children with cochlear implants	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Executive functioning and speech-language skills following long term use of cochlear implants	No	No – alternative intervention	No	Yes	No	No	No	n/a	n/a	n/a	No
Recognising diversity in deaf education	Yes	No	No	No	No	No	Yes	n/a	n/a	n/a	No **Use for intro – history**

Understanding language in the real world in *The Oxford Handbook of Deaf Studies in language: Research, policy and practice*	Yes	Yes – plus others	Yes	Yes	No	No	No	Yes	Book Chapter	Yes	Yes
Are deaf students visual learners?	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Effects of hearing loss and sign language use on working memory	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No
Understanding language, hearing status and visual spatial skills	No	No	No	No	No	No	No	n/a	n/a	n/a	No
The signed verbal learning test: Assessing verbal memory of deaf signers	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No
Haptic spatial configuration learning in deaf and hearing individuals	No	No	No	No	No	No	No	n/a	n/a	n/a	No

Accommodations quality for students who are deaf or hard of hearing	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
Mobile to speech captioning services: an accommodation in STEM laboratory courses	Yes	No- alternative intervention	Yes	Yes	No	Yes	No	Yes – powerpoint presentation	n/a	n/a	No
Deaf / hard of hearing and other post secondary learners' retention of STEM content with tablet computer based notes	Yes	No – alternative intervention	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
On language acquisition in speech and sign: development of combinatorial structure in both modalities	Yes	Yes	No	No	No	No	No	n/a	n/a	n/a	No

Coarticulation of hand height in sign language of the Netherlands is affected by contact type	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No
Sign language and spoken language development in young children: measuring vocabulary by means of the CDI in *Sign language research, uses and practices: crossing views on theoretical and applied sign language linguistics*	Yes	Yes	Yes	Yes	No	No	No	On Google books	n/a	n/a	No
Reading books with young deaf children: Strategies for mediating between ASL and English	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes

Word recognition in deaf readers: cross language activation of German sign language and German	No	Yes	No	No	No	Yes	No	n/a	n/a	n/a	No
Bilingual word recognition in deaf and hearing signers: Effects of proficiency and language dominance on cross-language activation	No	Yes	No	No	No	Yes	No	n/a	n/a	n/a	No
Emic perspectives on reading development in American Sign Language / English bilingual deaf children	Yes	Yes	Yes	Yes	No	Yes	No	No	n/a	n/a	No

Deaf and hard of hearing students' through the air English skills: A review of formal assessments	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Acquisition of tense marking in English speaking children with cochlear implants	Yes	No	No	No	No	Yes	No	n/a	n/a	n/a	No
Grammatical outcomes of 3- and 6-year old children who are hard of hearing	Yes	No	No	No	No	Yes	No	n/a	n/a	n/a	No
Is reading different for deaf individuals? Reexamining the role of phonology	No	No	No	No	No	Yes	No	n/a	n/a	n/a	No
Complex word reading in Dutch deaf children and adults	Yes	No	No	No	No	Yes	No	n/a	n/a	n/a	No

Reading and deaf individuals: Perspectives on the qualitative similarity hypothesis	No	No	No	No	No	Yes	No	n/a	n/a	n/a	No
Outcomes of early- and late-identified children at 3 years of age: Findings from a prospective population based study	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
A systematic review of cross-linguistic and multilingual speech and language outcomes for children with hearing loss	Yes	No	No	No	Yes	No	No	n/a	n/a	n/a	No
Simultaneous development of 2 oral languages by child cochlear implant recipients	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No

Practices in habilitation of pediatric recipients of cochlear implants in India: A survey	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Responding to cultural and linguistic diversity among deaf and hard of hearing learners in *Educating deaf learners*	Yes	Yes	Yes	No	Yes	No	Yes	No	n/a	n/a	No
Best practices in family-centered early intervention for children who are deaf or hard of hearing: An international consensus statement	Yes	No	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Emerging signers programme process and procedures outline	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No
NTID at a glance	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No

| Interpreting and RID overview | No | Yes | No | No | No | No | No | n/a | n/a | n/a | No |

Appendix 3: Articles from Bibliography Review Two

Article	DHH Education implied	Sign Language mentioned / implied	Inclusion mentioned / implied	Focus on other areas	Multilingual other than sign language	Subject specific	Too many variables?	Available	Peer reviewed	Education	Include in review?
Age dependent cost-utility of paediatric cochlear implantation	No	No	No	No	No	No	n/a	n/a	n/a	n/a	No
Principles and guidelines for early intervention after confirmation that a child is DHH	Yes	Yes	Yes	Yes	No	No	No	No	n/a	n/a	No
Decision making related to communication	No	No	No	No	No	No	Yes	n/a	n/a	n/a	No
Hands and Voices – Communication considerations	No	Yes	Yes	Yes	No	No	No	Yes	No	n/a	No

Identification of effective strategies to promote language in deaf children with cochlear implants	Yes	Yes	Yes	Yes	No	No	No	Yes	Dissertation	n/a	No
Effects of maternal sensitivity and cognitive and linguistic stimulation on cochlear implant users' language development over four years	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Predictors of hearing aid use time in children with mild- to severe-hearing loss	No	No	No	No	No	No	No	n/a	n/a	n/a	No

Measuring costs and outcomes of tele-intervention when serving families of children who are DHH	No	No – alternative	No	No	No	No	No	n/a	n/a	n/a	No
2013 CDC data	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Outcomes of 3 year old children with hearing loss and different types of additional disabilities	Yes	No	Yes	No	No	No	Yes	n/a	n/a	n/a	No
Deaf education teacher programmemes	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
DEC recommended practices in early intervention / early childhood special education	Yes	Yes?	Yes	No	No	No	No	No	n/a	n/a	No

Hearing loss and congenital CMV infection: A systematic review	No	No	No	No	No	No	No	n/a	n/a	n/a	No
A practical guide to the use of tele-intervention in providing listening and spoken language services to infants and toddlers who are DHH	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Cochlear implantation among deaf children with additional disabilities: Parental perception of benefits, challenges and service provision	No	No	No	No	No	No	Yes	n/a	n/a	n/a	No

Being a deaf student: Changes in characteristics and needs	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
A retrospective multicenter study comparing speech perception outcomes for bilateral implantation and bimodal rehabilitation	No	Yes	Yes	Yes	No	No	Yes	n/a	n/a	n/a	No
Simultaneous communication and cochlear implants in the classroom	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No
Curriculum design in Dutch deaf education	Yes	No	Yes	Yes	No	No	Yes	n/a	n/a	n/a	No
Classroom adaptations for effective learning by deaf students in *Educating deaf learners*	Yes	Yes	Yes	Yes	No	No	No	Yes	Book Chapter	Yes	Yes

Language assessment of deaf learners	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
Quality of instruction in bilingual schools for deaf children in *Bilingualism and Bilingual Deaf Education*	Yes	Yes	Yes	No	No	No	No	Yes	Book Chapter	Yes	Yes
Foundations for language development in deaf children and the consequences for communication choices in *The Oxford Handbook of deaf studies in language*	Yes	Yes	Yes	Yes	No	No	No	Yes	Book Chapter	Yes	Yes
Educating deaf students in a global context	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No

Language and literacy development of DHH children: Successes and challenges	Yes	No	Yes	Yes	No	Yes	No	n/a	n/a	n/a	No
Re-envisioning learning and teaching in deaf education: towards new transactions between research and practice	Yes	No	Yes	No	No	No	No	n/a	n/a	n/a	No
Relationships between spoken word and sign processing in children with cochlear implants	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Widening the lens: what the manual modality reveals about language, learning and cognition	Yes	Yes	Yes	Yes	No	No	No	No	n/a	n/a	No

Hands and voices – Communication Consideration Total Communication	No	Yes	Yes	No	No	No	No	Yes	No	n/a	No
Language as a multimodal phenomenon: Implications for language learning, processing and evaluation	Yes	Yes	Yes	Yes	No	No	No	No	n/a	n/a	No
The influence of communication mode on language development in children with cochlear implants in *Bilingualism and Bilingual Deaf Education*	Yes	Yes	Yes	Yes	No	No	No	Yes	Book Chapter	Yes	Yes

Phonological awareness: explicit instruction for young DHH children	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
Similar digit based working memory in deaf signers and hearing non-signers despite digit span differences	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Word and world knowledge among deaf learners with and without cochlear implants	Yes	No	No	No	No	No	No	n/a	n/a	n/a	No
Spoken English language development among native signing children with cochlear implants	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes

The association between visual non-verbal cognitive abilities and speech phonological processing vocabulary and reading outcomes in children with cochlear implants	Yes	Yes	Yes	Yes	No	Yes	Yes	n/a	n/a	n/a	No
How does visual language affect crossmodal plasticity and cochlear implant success	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No
Navigating two languages in the classroom: Goals evidence and outcome in *Bilingualism and Bilingual deaf education*	Yes	Yes	Yes	No	No	No	No	Yes	Book Chapter	Yes	Yes

Predicting academic achievement of DHH students from individual household communication and education factors	Yes	No	Yes	Yes	No	No	Yes	n/a	n/a	n/a	No
Sign bilingual and co-enrollment education for children with cochlear implants in Madrid Spain in *Bilingualism and Bilingual deaf education*	Yes	Yes	Yes	No	No	No	No	Yes	Book Chapter	Yes	Yes
Deaf native signers are better readers than non-native signers	No	Yes	Yes	No	No	Yes	No	n/a	n/a	n/a	No
Social cognition for learning as a deaf student	Yes	No	Yes	No	No	No	No	n/a	n/a	n/a	No

Deaf students metacognitive awareness during language comprehension	Yes	No	Yes	No	No	Yes	No	n/a	n/a	n/a	No
Language and literacy skills in children with cochlear implants: Past and present findings	Yes	No	Yes	No	No	Yes	No	n/a	n/a	n/a	No
Improving deaf childrens' working memory through training	Yes	No	Yes	No	No	No	No	n/a	n/a	n/a	No
Making sense of an unexpected detrimental effect of sign language in a visual task	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes

Vocabulary knowledge of deaf and hearing post-secondary students	Yes	No	Yes	No	No	No	No	n/a	n/a	n/a	No
Superior spatial touch: Improved haptic orientation processing in deaf individuals	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Social integration of DHH students in a sign bilingual and co-enrollment environment in *Bilingualism and Bilingual deaf education*	Yes	Yes	Yes	Yes	No	No	No	Yes	Book Chapter	Yes	Yes

Appendix 4: Articles from Bibliography Review Three

Article	DHH Education implied	Sign Language mentioned / implied	Inclusion mentioned / implied	Focus on other areas	Multilingual other than sign language	Subject specific	Too many variables?	Available	Peer reviewed	Education	Include in review?
American Sign Language / English bilingual model: A longitudinal study of academic growth	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes
Expressive vocabulary morphology syntax and narrative skills in profoundly deaf children after cochlear implantation	Yes	No	No	Yes	No	Yes	Yes	n/a	n/a	n/a	No

Verbal cognition in deaf children using cochlear implants: Effect of unilateral and bilateral stimulation	Yes	No	NO	NO	No	No	No	n/a	n/a	n/a	No
Communication outcomes for groups of children using cochlear implants enrolled in auditory-verbal, aural-oral and bilingual-bicultural early intervention programmemes	Yes	Yes	Yes	Yes	No	No	Yes	n/a	n/a	n/a	No
Emotion understanding in deaf children with a cochlear implant	Yes	No	Yes	No	No	No	No	n/a	n/a	n/a	No

Longitudinal speech perception and language performance in paediatric cochlear implant users: The effect of age at implantation	No	No	No	No	No	No	No	No	No	No	No
Consonant development in paediatric cochlear implant users who were implanted before 30 months of age	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Phonetic processing during the acquisition of new words in 3- to 6-year old French speaking deaf children with cochlear implants	Yes	No	No	No	No	Yes	No	n/a	n/a	n/a	No

Enhancing academic and social outcomes: Balancing individual family and school assets and risks for DHH students in general education	Yes	No	Yes	No	No	No	Yes	n/a	n/a	n/a	No
Research on language development: discourses on learning and messages to family support after CI	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Exploring the discourse on communication modality after cochlear implantation	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No

Synchrony complexity and directiveness in mothers' interactions with infants pre- and post-cochlear implantation	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Revisiting the adaptive and maladaptive effects of crossmodal plasticity	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Ensuring language acquisition for deaf children: What linguists can do	Yes	Yes	No	No	No	No	No	n/a	n/a	n/a	No
Bimodal bilingual cross-language interaction: Pieces of the puzzle in *Bilingualism and Bilingual deaf education*	Yes	Yes	Yes	Yes	No	No	No	Yes	Book Chapter	Yes	Yes

Social support for parents of deaf children: moving towards contextualised understanding	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Developmental and crossmodal plasticity in deafness: Evidence from the P1 and N1 event related potentials in cochlear implanted children	No	No	No	No	No	No	No	n/a	n/a	n/a	No
Get a little help from a word: Multimodal input facilitates 26-month olds ability to map and generalise arbitrary labels	No	No	No	No	No	No	No	n/a	n/a	n/a	No
CBS Netherlands 2013 *(Bureau of Statistics)*	No	No	No	No	No	No	No	n/a	n/a	n/a	No

Appendix 5: Articles from Bibliography Review Four

Article	DHH Education implied	Sign Language mentioned / implied	Inclusion mentioned / implied	Focus on other areas	Multilingual other than sign language	Subject specific	Too many variables?	Available	Peer reviewed	Education	Include in review?
First language acquisition differs from second language acquisition in pre-lingually deaf signers: Evidence from sensitivity to grammaticality judgement in BSL	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No
How far and how fast: A longitudinal study on ASL acquisition in adolescent home signers	Yes	Yes	No	No	No	No	No	n/a	n/a	n/a	No

Crossmodal language activation: Does processing a sign (L1) also activate its corresponding written translations (L2)?	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No
More than the sum of the parts: bimodal bilingual language acquisition – phonological aspects	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No

Bimodal bilinguals; cognitive advantages in multimodal coordination? Linking unique bimodal language processes to cognitive control in speech-sign bilinguals	No	Yes	No	No	No	No	No	n/a	n/a	n/a	No
Language processing in children with cochlear implants: A preliminary report on lexical access for production and comprehension	Yes	No	No	No	No	No	No	No	n/a	n/a	No
Enhanced cognition from L2 BSL acquisition	Yes	Yes	Yes	No	No	No	No	No	n/a	n/a	No

Appendix 6: Abstract Analysis

Article	Signed Language(s) Sign language(s); signing / signed / signer; BSL; ASL; bimodal / multimodal (communication); language / communication mode / modalities; sign bilingual; total communication; simultaneous communication	Education Teaching; learning; academic; learners; students; pupils; teachers; educators; school; college; university; classroom	Inclusion Inclusive; outcomes; HWB; academic achievement / attainment / performance / success / progress / growth; social integration; early intervention; accommodation; differentiation; adaptation; development / develop	Include Article
Deafness and Diversity: Reflections and directions	1	2	2	Yes
Explicitly teaching English through the air to students who are deaf or hard of hearing	1	3	1	Yes
The English Language and Reading achievement of a cohort of Deaf students speaking and signing standard English	3	4	4	Yes
Written forms of signed languages: A route to literacy for Deaf Learners?	3	1	0	No

DHH College and High School Students perceptions of speech-to-text and interpreting / note taking services and motivation	0	4	1	No
Don't assume Deaf students are visual learners	3	16	1	Yes
The impact of input quality on early sign development in native and non-native language learners	5	0	1	No
Effects of SES on Literacy development of Deaf signing bilinguals	5	3	1	Yes
Professionals guidance about spoken language multilingualism and spoken language choice for children with hearing loss	0	2	0	No
A preliminary study on interpreting for emergent signers	5	1	0	No
Teaching Maths vocabulary with an interactive Maths signing dictionary	6	12	1	Yes
Signing avatars: using virtual reality to support students with hearing loss	3	4	2	Yes

Deafness and Diversity: Early Intervention	0	2	3	No
Rethinking total Communication: Looking back moving forward in *The Oxford Handbook of Deaf Studies in language: Research, policy and practice*	11	2	0	No
Language use in the classroom: Accommodating the needs of diverse DHH learners in *Diversity in deaf education*	1	16	5	Yes
Understanding language in the real world in *The Oxford Handbook of Deaf Studies in language: Research, policy and practice*	2	6	2	Yes
Are deaf students visual learners?	2	9	1	Yes
Deaf / hard of hearing and other post secondary learners' retention of STEM content with tablet computer based notes	0	4	0	No

Reading books with young deaf children: Strategies for mediating between ASL and English	5	2	1	Yes
Deaf and hard of hearing students' through the air English skills: A review of formal	3	3	0	No
Best practices in family-centered early intervention for children who are deaf or hard of hearing: An international consensus statement	0	0	4	No
Classroom adaptations for effective learning by deaf students in *Educating deaf learners*	0	12	3	No
Quality of instruction in bilingual schools for deaf children in *Bilingualism and Bilingual Deaf Education*	0	8	3	No

Foundations for language development in deaf children and the consequences for communication choices in *The Oxford Handbook of deaf studies in language*	0	1	2	No
Relationships between spoken word and sign processing in children with cochlear implants	9	1	0	No
The influence of communication mode on language development in children with cochlear implants in *Bilingualism and Bilingual Deaf Education*	3	3	2	Yes
Spoken English language development among native signing children with cochlear implants	5	0	1	No
Navigating two languages in the classroom: Goals evidence and outcome in *Bilingualism and Bilingual deaf education*	5	7	3	Yes

Sign bilingual and co-enrollment education for children with cochlear implants in Madrid Spain in *Bilingualism and Bilingual deaf education*	4	4	1	Yes
Making sense of an unexpected detrimental effect of sign language in a visual task	3	0	0	No
Social integration of DHH students in a sign bilingual and co-enrollment environment in *Bilingualism and Bilingual deaf education*	2	11	2	Yes
American Sign Language / English bilingual model: A longitudinal study of academic growth	3	7	4	Yes
Bimodal bilingual cross-language interaction: Pieces of the puzzle in *Bilingualism and Bilingual deaf education*	4	1	1	Yes

Appendix 7: Article Summaries

Study Name	Author(s)	Year	Publication	Country	Study Design	Assignment to Condition	Gender	Communication Mode	Intervention Characteristics	Control Characteristics	Outcome Measures
			STUDY		METHODOLOGICAL		PARTICIPANT				
Reading books with young deaf children: Strategies for mediating between American Sign Language and English	Michele Berke	2013	Journal of Deaf Studies and Deaf Education	USA	Case Study *observation*	Mothers: *college experience;* Children*: 3-5 years old; diagnosis pre-6 months; no potential language concerns*	Parents - *all female;* Children - *not noted*	ASL = primary communication	Reading sessions (45-60 mins) videotaped at least twice. Books were new / unfamiliar. Books were narrative to allow for cognitive challenge; selected based on certain criteria. Reading sessions transcribed and analysed (using gloss system for ASL); reading techniques identified, coded and counted using software system to identify specific techniques used by Deaf mothers to make English explicit.	A second person, fluent in ASL and trained for the pilot study, provided a reliability check for the codes based on 7-minute clips from each of the transcripts / videos.	Deaf mothers made connections among ASL and printed text: *chaining; providing English definition; interpreting English word sounds; explaining differences in spelling of similar sounding words; explaining rhyming; explaining font sizes; using ASL to explain differences between both languages; following English text through ASL; various other techniques.* Deaf parents are making concrete connections between ASL and English, teaching children that books are something they can learn from and potentially increasing reading skills.

American Sign Language / English Bilingual Model: A longitudinal study of academic growth	Cheryl M Lange, Susan Lane-Outlaw, William E Lange, Dyan L Sherwood	2013	Journal of Deaf Studies and Deaf Education	USA	Longitudinal survey of assessment-based database entries	Three criteria: *(a) enrolled at Metro Deaf School for 4 years+; (b) min. five Northwestern Evaluation Association (NWEA) Measures of Academic Progress (MAP) reading or mathematics tests with no more than one missing record; (c) an initial NWEA Rasch unIT (RIT) score in reported range for national norm group*	n/a	ASL / English bimodal	The NWEA is a computer-adapted text which customises tests to individual students. From this, the Growth Index (GI) method is used to determine academic growth of individual students compared to students in the NWEA's normed database. It can also identify individual growth by calculating a gain score using spring-to-spring RIT scores.	National norming studies are conducted by NWEA and provide growth and status norms for all subtests. They are based on data from almost 3million students across 42 states. Each individual student's data in the study group was compared with a group of "like" students in the norm group. The comparison group is predominantly hearing students. Academic growth within the study group was also compared by gender, parent hearing status and presence of secondary disability. Students were also ranked at the end of the study using the NWEA 2008 norming criteria.	Initial reading and mathematics were less that those of comparison group; over time study group level of academic growth increased and exceeded comparison group after exposure to bilingual education. No statistical differences that levels of growth over time were affected by gender or by parental hearing status. Students without secondary disabilities had accelerated levels of growth compared to those with secondary disabilities. After min. 4 years exposure to bimodal education, 41% of study group was average or above avergae in reading and 55% were average or above average in mathematics

Are Deaf Students Visual Learners?	Marc Marschark, Carolyn Morrison, Jennifer Lukomski, Georgianna Borgna, Carol Convertino	2013	Learning and Individual Differences	USA	Survey - assessment of language background followed by administration of tests assessing visual-spatial functioning	Deaf students in Rochester Insitute of Technology (RIT), whose primary mode of communication was signed language (intentionally creating bias); amount of hearing varied and included CI users	18 male; 21 female	Primary mode of communication is sign language	Language and Communication Background Questionnaire (LCBQ) used a five point Likert scale to self-assess skills in understanding signed, simultaneous and spoken language. History of sign language use, hearing aids and CIs were also queried. Seven tests for visual-spatial abilities were administered in order to assess: *spatial relations, picture recognition, visual matching, decision speed, pair cancellation, embedded figures* and *Corsi tests*	32 hearing students (16 males and 16 females). All but four indicated not knowing any sign language; four indicated minimal knowledge.	There did not appear to be any particular advantage to deaf students in visual-spatial tests. Hearing peers significantly outperformed in two areas; there was marginal differences, if at all, in the remaining areas. Both groups showed spatial awareness related to their abilities in mathematical problems. Visual presentation of information does not necessarily support the learning of deaf pupils any more than it does for hearing pupils.

Teaching Mathematics with an Interactive Signing Math Dictionary	Judy Vesel, Tara Robillard	2013	Journal of Research on Technology in Education	USA	Descriptive case study: *classroom observation; open-ended interviews and artefacts (student work) in multiple case studies*	Each case study was one classroom in a specialised school for the deaf with an experienced teacher who had never used Signing Math Dictionary (SMD). Three case studies were in an urban school for the deaf; five were in a suburban school for the deaf. Both schools were in the Northeast.	n/a	ASL/ English	Teachers were observed teaching three lessons: *without SMD; introduction of SMD and lesson using SMD*. Study investigated how mathematics is taguht without SMD; how the SMD can be integrated and what the benefits of the SMD are.	n/a	SMD appears to contribute to giving students access to mathematics vocabulary in their own language. They may therefore be able to work more independently thus allowing teachers to focus more on the topic content. It can also allow for more standardised usage of signs to represent mathematical concepts as well as motivation and engagement.

| Explicitly teaching English through the air to students who are Deaf or hard-of-hearing | Jessica G Bennett, Ralph Gardner III, Ross Leighner, Shannon Clancy, Joshua Garner | 2014 | American Annals of the Deaf | USA | Experiment / case study of four participants | Participants were 11 years old (5th Grade); had parental permission; were at least 6 months behind chronological peers in reading development according to school's standardised assessments | 3 female; 1 male | ASL / total communication in school. Home language: Male = ASL; Females = English | Pupils were extracted individually (or in a pair) and worked through Language for Learning Curriculum. They were assessed every ten lessons using a Language for Learning probe and a language generalisation probe. The study aimed to investigate the impact of the Language for Learning curriculum on the accuracy of the students' language skills. | Second observers were in place during some of the intervention and testing. Sessions were also videotaped to allow for further review by second observers. | Results indicate a causal relationship between Language for Learning program and increased accuracy of through-the-air English skills for all participants during the intervention. Participants were able to use the skills gained on untrained stimuli and also maintained the skills over a 1-week and a 1-month period. This could allow teacher to quickly build DHH children's lexicons in order to allow them to catch up with hearing peers quickly. |

Bimodal Bilingual Cross-Language Interaction: Pieces of the Puzzle	Ellen Ormel, Marcel Giezen	2014	**Book**: Bilingualism and Bilingual Deaf Education *(eds. Marc Marschark, Gladys Tang, Harry Knoors)*	n/a *(focus on USA and Netherlands)*	**Book Chapter**: literature review	Articles pertaining to unimodal bilingualism and/or bimodal bilingualism	n/a	**Varied** - bilingual	**Varied** - examining effects of bilingualism on cross-language interactions; executive cognitive control abilities; age of acquisition of one or both languages; and language proficiency. Relates these factors to bimodal bilingualism specifically and examines the implications for the education of DHH children.	Explores a variety of articles including those focused on children bilingual in spoken languages rather than in both a spoken and a signed language.	**Cross-language interaction:** apparently present in bimodal bilingual users. May differ between hearing and deaf bimodal bilinguals and between bimodal bilinguals and unimodal bilinguals. **Cognitive Control:** paucity of research - enhanced cognitive control abilities in bimodal bilingual adults are unclear, as is whether they are the same as for unimodal bilinguals. No studies specifically investigate cognitive control in bimodal bilingual children. **Implications for Education:** based on research into age of acquisition and language proficiency, the suggestion is that DHH children be communicated with in signed and spoken language, in order to maximise stimulating communicative environments.

| Social Integration of Deaf and Hard-of-Hearing Students in a Sign Bilingual and Co-enrollment Environment | Kun-man Chris Yiu, Gladys Tang | 2014 | **Book:** Bilingualism and Bilingual Deaf Education *(eds. Marc Marschark, Gladys Tang, Harry Knoors)* | Hong Kong | **Book Chapter:** case study - *questionnaires* | 16 Deaf students: *enrolled in Sign Bilingualism and Co-enrollment Program (SLCO) program since Primary 1 (4-6 years enrollment); varying hearing loss; use of aids; and age of acquisition.* 65 hearing students: *44 enrolled in SLCO since Primary 1; 21 had transferred in interim (2-5 years experience)* | Varied | Bimodal bilingual (Cantonese / Hong Kong Sign Languag [HKSL]) | **Peer Ratings:** both DHH and hearing students asked to rate whether they liked to play or study with classmates based on visual scale of three faces (happy, neutral, sad). Face counts / mean scores attributed to each student in both study and play conditions. **Attitudinal Measures:** DHH students took an Attitudes Towards Deafness Scale; hearing students from both co-enrollment and hearing classes took Hearing Peers' Attitudes Towards DHH Students Scale. Both were 5-point Likert scales, implying that higher scores equal more positive attitudes. | 224 students from hearing classes were given the Hearing Peers' Attitudes Towards DHH Students Scale. | Attitudes to DHH students in co-enrollment settings were predicated on signed language rather than spoken language ability. DHH students were provided with socio-emotional support to develop positive attitudes towards their own deafness through bonding with hearing students and positive role models in the form of Deaf teachers and large numbers of DHH students. |

Sign Bilingual and Co-enrollment Education for Children with Cochlear Implants in Madrid, Spain	Mar Pérez Martin, Marian Valmaseda Balanzategui, Gary Morgan	2014	**Book:** Bilingualism and Bilingual Deaf Education *(eds. Marc Marschark, Gladys Tang, Harry Knoors)*	Spain	Longitudinal survey of language development of children with CIs, using variety of assessment instruments.	17 children (0-6 years) from 2010-2012. *Entire group receiving bilingual education in 2010; no additional disabilities; parents use Spanish or LSE; implanted pre-2-years-old*	Varied	Spanish / LSE bilingual	**Audition:** parental questionnaire (Little Ears) to obtain information about auditory behavior 2 years after implant. **Spoken Spanish:** vocab and grammar assessed with four tests (dependant on age). **LSE skills:** no standardised assessment - developed based on existing assessments for other signed languages. Three assessments provided (again, dependant on age). **Social-Emotional skills:** adaptation of French assessment of social-emotional skills.	**Little Ears:** Norms available. **Spoken Spanish:** Norms available in all four tests. **LSE skills:** norms unavailable. **Social-Emotional skills:** French norms available.	Good development of language - much variability between children and aspects of language evaluated. Initial preference for LSE over Spanish post-implantation suggests need for diversity of language experience. Vocabulary development tends to be better developed than grammar development - typical of hearing bilinguals too. Children appear well-adapted and able to cope with social-emotional demands of co-enrollment environment indicating interaction between social-emotional development and bilingualism. Previously noted that early CI implantation reduces nerves in hearing parents and promotes more natural familial interaction.

Navigating Two Languages in the Classroom: Goals, evidence and outcomes	Marc Marschark, ChongMin Lee	2014	**Book:** Bilingualism and Bilingual Deaf Education *(eds. Marc Marschark, Gladys Tang, Harry Knoors)*	n/a *(focus on USA and Sweden)*	**Book Chapter**: literature review	Articles pertaining to unimodal bilingualism and/or bimodal bilingualism	n/a	**Varied** - bilingual	**Varied** - examining effects of bilingual education on DHH learners , regardless of whether the setting is formally described as a bilingual. It also aims to distinguish the academic effects of DHH children having early access to language rather that a specific modality.	Explores a variety of articles focusing on the history of bilingual education; cognition; Scandinavian Education; reading achievement; simultaneous communication; use of bilingualism in the classroom and the implications for the future of DHH education.	Indicates literature pertaining to DHH bilingual education is not necessarily comprehensive or conclusive. Older studies seemed to indicate academic advantages for DHH children with DHH parents over DHH children of hearing parents. Recent studies indicate positive relationships between sign language skills and literacy but do not distinguish between benefits of early sign language and early language. Recognises difficulties of empirical research amongst DHH students as they are not homogeneous. Further research suggested in simultaneous communication; bilingualism at home; Deaf identity and academic impact of differences in cognition.

The Influence of Communication Mode on Language Development in Children with Cochlear Implants	Elizabeth A Walker, J Bruce Tomblin	2014	**Book:** Bilingualism and Bilingual Deaf Education *(eds. Marc Marschark, Gladys Tang, Harry Knoors)*	n/a *(focus on USA; some Netherlands and Norway)*	**Book Chapter:** literature review	Articles pertaining to communication mode in DHH children with CIs. Largely focused on comparing Total Communication (TC) with auditory-oral communication (OC)	n/a	**Varied -** some TC and some OC; all CI implanted	**Varied -** examining the benefits (and drawbacks) of different communication modes in children with CIs with regard to speech and language outcomes; exploring factors other than communication mode such as residual hearing, age at implantation daily CI use and parental goals.	Explores a variety of articles focusing on the history of TC and OC modes (including pre-CI); comparing the impact of TC with the impact of OC; some articles compared one or both TC/OC with hearing peers; some articles considered other additional factors influencing speech and language development.	The main consideration is the lack of empirical, evidence-based research as a result of researcher's strong philosophical beliefs. Most studies point to positive outcomes in OC settings, however there are caveats in that children attending OC settings tend to be of higher SES / show early propensity for spoken language. Positive outcomes for children with CIs also depend on various other factors: residual hearing, age at implantation daily CI use and parental goals. There is no evidence that sign language prevents development of oral language skills, especially early in development. Calls for further research into effects of early sign language use.

Effects of SES on Literacy Development of Deaf Signing Bilinguals	Paul Twitchell, Jill P Morford, Peter C Hauser	2015	American Annals of the Deaf	USA	Survey - *questionnaire; assessment of ASL proficiency; assessment of reading proficiency*	135 children and adults (6-26 years old): *hearing loss greater than 85dB in better ear; additional disabilities (learning, neurological, visual) were excluded*	Varied	ASL-English bilingual	**SES:** parents completed questionnaire used to assign participants score on Hollingshead (1975) SES scale. **ASL proficiency:** instrument used was ASL Sentence Reproduction Test. Scores were modified bu calculating mean and standard scores for three age groups (in absence of satndardised norms). **Reading proficiency:** Peabody Individual Achievement Test-Revised used to measure English reading ability.	DoD and DoH assessed simultaneously based on ASL proficiency, emabling fuller representation of target population than previous studies.	SES has a direct impact on ASL-blinguals' L2 literacy success. This is independent of and additional to benefits of L1 proficiency in ASL. SES and ASL proficiency are not correlated for deaf signing bilinguals. Future research should examine linguistic and social interactions affecting language and literacy acquisition during childhood; different types of literacy mediation between monlingual / bilingual parents and deaf children; and different roles played by SES in ASL-English bilingual language and literacy outcomes.

| Understanding Language in the Real World | Marc Marchark, Elizabeth Jackson Machmer, Carol Convertino | 2015 | **Book:** The Oxford Handbook of Deaf Studies in Language *(eds. Marc Marschark and Patricia Elizabeth Spencer)* | n/a *(focus largely on USA)* | **Book Chapter:** literature review | Articles pertaining to differences in cognition and learning examining how language use affects real world cognition. | n/a | **Varied** | **Varied:** exploring articles relating to hearing status; use of sign language, spoken language or both; cochlear implant use; other developmental factors and the impact that these have on cognitive function in DHH individuals and how these mayt affect academic outcomes. | Explores a variety of articles focusing on a variety of communication modes and the resulatant effects on linguistic and cognitive ability. | Three general conclusions: **(1)** acquisition of communication / language skills at (or around) age-appropriate times is neccessary for development of 'normal' cognitive / social-emotional skills / subsequent language development and world knowledge. **(2)** Understanding how DHH children learn; building on cognitive / linguistic strengths & accomodating needs in more important than language of education. **(3)** More empirical (less polemic) evidence is needed to make progress in improving academic, personal and employment outcomes for DHH learners. |

Title	Author	Year	Journal	Country	Type	Focus		Language	Exploration	Exploration 2	Conclusions
Signing Avatars: Using Virtual Reality to Support Students with Hearing Loss	Nichole K Zirzow	2015	Rural Special Education Quarterly	USA	Literature review (/ product review?)	Articles reviewing / exploring the effects of specific virtual reality (VR) products / avatars	n/a	ASL	Exploring articles and products in order to highlight availability and impact of VR / avatar technology to aid DHH pupils through use of signed language.	Reviews of variety of products and acknowledgement of challenges and limitations.	DHH students are increasingly included in mainstream education, maximising social integration. This may cause curricular /academic struggles. Needs to be further development of strategies to aid language and literacy development and utilise assistive technologies to enhance learning outcomes. VR / avatars can assist educators to address needs of DHH learners.
Deafness and Diversity: Reflections and Directions	Caroline Guardino, Joanna E Cannon	2016	American Annals of the Deaf	USA	Literature review	Articles reflecting on the application of research, theory and practice regarding Deaf and Diverse (DAD) learners (i.e. Learners with additional disabilities / additional multilingual backgrounds)	n/a	**Varied:** including ASL / languages other than ASL or English	Exploring articles relating to: *early intervention (EI); communication / language; assessment / transition / teacher preparation* in relation to DAD learners	Exploration of a variety of articles examining a variety of topics in relation of DHH children and the impacts on educational practice.	Professionals must reduce potential personal biases / assumptions they have regarding disability, multilingualism and culture; respect the needs and preferences of learners and undertake further research to address needs of DHH learners.

Title	Authors	Year	Journal	Country	Methodology	Participants	Gender	Language	Assessments	Reliability	Findings
The English-Language and Reading Achievement of a Cohort of Deaf Students Speaking and Signing Standard English: A Preliminary Study	Diane Corcoran Nielsen, Barbara Luetke, Meigan McLean, Deborah Stryker	2016	American Annals of the Deaf	USA	Case Study: *assessemnt data across a number of areas*	17 pupils enrolled in school for deaf using Signed Exact English (SEE): *no additional disabilities; normal intelligence; English-speaking parents; hearing loss at young age; all wore amplification at home and school (11 CIs); parental permission provided*	8 = boys 9 = girls	Monolingual speakers of Standard American English; SEE used in school	School assesses twice per year: **English Language -** Photo Articulation Test (PAT-3, 1997); SPELT (expressive structured language sample) plus usntructured language samples from TOD; CELF-4 (standardised assessment of Standard English). **Reading -** GMRT; researcher-created assessment (Morphological Awareness [MA] task).	**PAT-3:** test norms not used as designed for hearing children 3-8yo and all participants 8+ - raw score used instead. **Unstructured language samples:** two of six teachers filmed themselves and rewatched to ensure accurate scoring. **CELF-4:** TOD administered - TOD unaware data would be used for study; data verified by four professionals. **GMRT:** administered by researcher (with exception of one class) data verified by four professionals. **MA task:** based on linguistic information from Developmental Language Curriculum (Cheney, Compton and Harder 1988)	Developmental trend (and no plateau) in English-language and reading achievement of students. Older scored higher than younger. More than half showed average / above average command of morphology / syntax. MA necessary to receive high test score; speech not significantly correlated with language skills / reading achievement. Higher English-language ability scored higher in tests of reading vocabulary & comprehension. Generally read within average rage compared to hearing peers in standardised assessment. Language proficiency predicted reading achievement. Further research suggested to focus on other reading-related variables.

Title	Authors	Year	Journal	Country	Method	Sample		Varied	Measures	Comparison	Findings
Don't Assume Deaf Students are Visual Learners	Marc Marschark, Allan Paivo, Linda J Spencer, Andreana Durkin, Georgianna Borgna, Carol Convertine, Elizabeth Machmer	2016	Journal of Developmental and Physical Disabilities	USA	Survey - *questionnaires and interview*	102 Deaf students at Rochester Institute of Technology (RIT) volunteered. 50 used CIs (varied age of implantation); 46 CI users and 51 non-CI users could use sign language to discuss basic topics. 65% CI users and 90% non-CI users could have natural signed discussion.	n/a	Varied	**Learning styles:** Individual Differences Questionnaire (IDQ 1971) - *visual and verbal abilities*; Index of Learning Styles (ILS 2004, 2005) - *dimesions of learning style.* **Language:** Language and Communication Background Questionnaire (LCBQ) - *five point Likert scale: skills in sign and spoken language;* Sign Language Proficiency Interview (SLPI) - *6 point Likert scale: skills in sign language*; Harvard Auditory Test - *receptive sign language skills.* **EF:** LEAF (2014b, 2009) - *self-report about recent experiences and behaviours*	21 hearing students at Rochester Institute of Technology (RIT) volunteered. 10 of the 21 indicated varying levels of sign language skill.	There is no reason to conclude that deaf college students are more likely to be visual learners than their hearing peers. Deaf college students do not see themselves as stronger in visual abilities or visual preferences than hearing peers. Deaf college students who rely primarily on sign language are no more likely to be visual learners than deaf peers who rely primarily on spoke language. Deaf students who have greater access to spoken language through CI use do not demonstrate disadvantage in visual-spatial domain or in liklihood of being visual learners.

Title	Author	Year	Source	Participants	Type	Focus	Sample	Areas Explored	Analysis	Findings
Language Use in the Classroom: Accomodating the Needs of Diverse Deaf and Hard-of-Hearing Learners	Harry Knoors	2016	**Book:** Diversity in Deaf Education	n/a - *various*	**Book Chapter:** literature review	Articles exploring classroom language / interaction and its impact on learning, particularly in the context of DHH learners.	n/a	**Varied** including spoken / signed / simultaneous	Articles explored areas such as: *linguistic diversity; classroom interaction; language use; classroom management, instructional and emotional support; accomodating needs of diverse DHH learners and differentiation.*	Discussion of a number of articles - including those examining the effects of language use on hearing students based on the same areas.	DHH students are linguistically diverse learners. Accommodating needs take place through differential teaching which may imply adapting language use in the classroom - but only if language is the factor which causes variation in learning. Applying a multitier approach to accomodating the needs of DHH learners seems to be an appropraite measure, combined with adequate grouping and proper timing of differentiation. A narrow focus on classroom language should be avoided. There is no point in identifying a sole language which will tackle the needs of DHH learners - "one size fits none" (p.240)