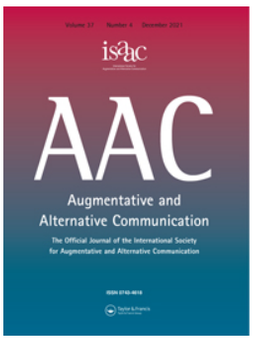
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The development of a core key word signing vocabulary (Lámh) to facilitate communication with children with down syndrome in the first year of mainstream primary school in Ireland

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ABSTRACT

Key word signing, an unaided augmentative, and alternative communication (AAC) system is commonly used by children with Down syndrome who attend mainstream primary schools. To ensure the successful use of key word signing within a mainstream environment, a meaningful, contextually appropriate sign vocabulary must be available to all communication partners. The aim of this study was to develop a core school-based key word signing vocabulary to facilitate effective communication between children with Down syndrome and their communication partners in the first year of mainstream primary school. Four key groups—participants with Down syndrome, their peers, teachers, and special needs assistants—and a speech-language pathologist contributed to the vocabulary over the course of an academic year, through observations, semi-structured interviews, and guided tours of the school environment. Based on criteria of frequency and commonality, 140 words were considered to be core vocabulary. The current study provides new insights into the complex process of vocabulary selection for children who use key word signing at school and highlights the importance of access to a functional sign vocabulary in facilitating inclusive education practices.

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Children with Down syndrome have historically experienced significant barriers to accessing mainstream primary education; today, however, the right to education within a mainstream environment for all children in Ireland is set out in law (Kelly, Devitt, O'Keeffe, & Donovan, 2014). In this context, the focus of research has turned to investigate factors that affect the quality of inclusive education practices. Children with Down syndrome have speech and language difficulties that are disproportionate to their level of intellectual disability (Cleland, Wood, Hardcastle, Wishart, & Timmins, 2010; Frizelle, Thompson, Duta, & Bishop, 2018) and consequently can benefit from the use of augmentative and alternative communication (AAC). Language difficulties are a significant barrier to their inclusion in mainstream school and their expressive language skills, in particular, have been reported to be the strongest predictor of teacher ratings of classroom inclusion (Engevik, Naess, & Berntsen, 2018). In contrast to their language skills, children with Down syndrome show relative strengths in their visual memory skills, which are often reported to be in keeping with typically-developing children of a similar mental age (Jarrold & Baddeley, 1997).

One method of AAC that can provide support for the challenges associated with significant speech and language difficulties, while capitalizing on strengths in visual memory, is key word signing. This involves using manual signs alongside speech to augment the most salient words in a sentence (Rombouts, Maes, & Zink, 2017). With an appropriate set of vocabulary available, the use of key word signing in mainstream primary school has the potential to enhance communication, support academic learning and promote inclusive education. However, without adequate signing resources or supports, in particular, a sign vocabulary that is comprehensive in meeting the needs of children and their communicative partners in a school context, key word signing will not be effective as a system of communication. This is the focus of the current study, in which a core school-based key word signing vocabulary is developed to address the communication and learning needs of children with Down syndrome in their first year of mainstream primary school.

Key word signing is a form of unaided AAC, in that it does not utilize physical or external aids (Smidt et al., 2019). Key word signing systems have been developed all over the world, and while they include some signs from their respective country's natural signing system (e.g., of the Deaf community), they do not use the full breadth of the established sign language (Frizelle, 2019; Glacken et al., 2019). In contrast to natural signing systems, key word signing systems combine the visual with the spoken word; they do not mark grammatical forms; sign vocabularies are devised rather than

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Supplemental data for this article can be accessed here.

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developing naturally over time; they are more iconic than natural sign languages (Rombouts, Maessen, Maes, & Zink, 2020); efforts are made to simplify complex hand positions; and less emphasis is placed on finger spelling. Lámh (meaning *hand* in Irish) is the key word signing system used by people with communication difficulties in Ireland, with many of the signs rooted in Irish Sign Language (ISL). The core Lámh vocabulary consists of 580 signs, which are classified as actions, modifiers, objects, people, and social words. An "expert opinion" rather than an empirical approach was taken in devising the vocabulary.

Although key word signing is one of several AAC methods there is now sufficient evidence to show that it can promote the development of spoken language in people with Down syndrome (Launonen, 2019; Vandereet, Maes, Lembrechts, & Zink, 2011). Consequently, it is reported to be the second most widely used SLP intervention in disability services in Ireland (Byrne, Pyne, & Sheehan, 2019) and is used extensively by children and adults with Down syndrome (Down Syndrome Ireland, 2014; Wright, Kaiser, Reikowsky, & Roberts, 2013). Key word signing capitalizes on several key strengths for people with Down syndrome, such as gesture, with Zampini and D'Odorico (2009) reporting that at 36 months, children with Down syndrome produce the same gesture types at the same frequency or higher frequencies than their typically-developing peers. Signs can be used to support both receptive and expressive language. They are produced ~1.5 times more slowly than speech, therefore allowing more time to decode information and thus facilitating comprehension (Emmorey, 2002). In addition, word boundaries become more perceptible when signs are used to support speech, and signing only the key words within a sentence reduces the complexity of the message (Rombouts et al., 2017). Signs also capitalize on the visual memory strengths of people with Down syndrome and place fewer demands on working memory than other more high-tech AAC systems, which can involve scrolling through multiple pages of an interface to select a target word or phrase, thereby slowing down the communicative process (Thistle & Wilkinson, 2013). Additionally, children with Down syndrome can have difficulty identifying graphic symbols due to cerebral visual impairment (Wilton, Woodhouse, Vinuela-Navarro, England, & Woodhouse, 2021). Key word signing helps to overcome the oromotor difficulties evinced by people with Down syndrome in that it involves using the hands (with simplified hand positions) and body (Woll & Grove, 2019). In addition, communicating with key word signs necessitates that the signing partner must first gain eye contact, which ensures joint attention, an essential pre-requisite for language learning opportunities (Clibbens, Powell, & Atkinson, 2002). It is these characteristics of key word signing that have ensured its continued effective use with people with Down syndrome, even in the context of ever-increasing high-tech AAC options.

The status of key word signing in schools has undergone a radical shift in the last 50 years, from being viewed as a method of communication reserved for children deemed unsuitable for mainstream education settings, to being considered a good example of inclusive practice around the world (Rombouts, Sheehy, Buchanan-Mellon, & Grove, 2019). Although the demands associated with implementing key word signing during daily activities in a school setting are widely acknowledged (Rombouts, Maes, & Zink, 2018), the necessary resources to facilitate its effective use are very often absent. Research suggests that, even in schools where key word signing is actively used, it is likely to be used in a restricted way, with emphasis on correcting breakdowns, maintaining focus, or labeling (Parkhouse & Smith, 2019). This narrow use of signs imposes limits on both the child with Down syndrome (who is reliant on key word signing to augment their communication) and their communication partners. To support effective communication, teachers are increasingly expected to model signs during classroom activities as an indirect instructional strategy for both sign users and their peers (Dodd & Gorey, 2014; Wright et al., 2013). Effective modeling requires teachers to not only be "confident, fluent and accurate signers" (Smidt et al., 2019, p. 56) but also be able to access an appropriate vocabulary of signs that meet the needs of children, specifically in a school context. Limited availability of appropriate training, due to lack of school-specific courses and other resources, makes it difficult for the relevant and consistent use of signs in the school environment to become a reality (Rombouts et al., 2018).

In Ireland, the Lámh Module 1 course is the entry level key word signing training for teachers and school staff, in which 100 signs are taught. The course content is aimed at a broad range of communication partners and professionals who may be supporting Lámh users of all ages across a multitude of settings (Lámh, n.d.). As such, while the course covers an introduction to AAC, as well as the concept of a signing environment, the 100 core signs taught are not specific to the school environment and are not included with the aim of accommodating the communication needs of young children. This course is currently the only funded Lámh training available to teachers who have students with Down syndrome in their class. For AAC to be used successfully, children and their communication partners must have access to vocabulary that is comprehensive, appropriate to age and group membership, and tailored to the context of communication (Dark & Balandin, 2007). If Lámh is to be used as an effective form of communication and as a support to academic learning, it is essential that those attending and working in school are equipped with a core key word signing vocabulary tailored to the specific needs of the environment in which they learn and work.

While children who communicate primarily using spoken language have a community of natural users around them, children who use key word signing are typically reliant upon partners who themselves are trying to learn the modality. In addition, those who use key word signs and other forms of AAC are reliant on parents and professionals to ensure that appropriate vocabulary is available and prioritized (Laubscher & Light, 2020). Vocabulary prediction and selection for AAC users is considered a complex and time-consuming task and is often assigned to speech-language pathologists or other professionals, such as teachers, who may have little prior

experience with the protocols (Trembath, Balandin, & Togher, 2007). The identification of a core vocabulary, a set of words that can be used with multiple communication partners across a range of contexts, is one of the most widely recommended strategies to assist in predicting and selecting vocabulary for children who use AAC (Boenisch & Soto, 2015).

Most previous studies in which core vocabulary has been identified have focused on preschool children with typical development (see Banajee, Dicarlo, & Buras Stricklin, 2003; Fallon, Light, & Paige, 2001; Mngomezulu, Tönsing, Dada, & Bokaba, 2019; Trembath et al., 2007). For school-age children, vocabulary selection is a more difficult process as vocabulary is needed to support the growing and complex communication demands of the school environment. Signs are required to support not only social interactions with a range of communication partners but also academic achievement, including classroom participation, language development, and the development of early literacy and numeracy skills. Boenisch and Soto (2015) carried out a study of core vocabulary selection based on samples from typically developing school-aged children; however, given the older age range (7–14 years) of the participants, the findings are unlikely to reflect the needs of 5-year-old children with Down syndrome.

Previous studies that have involved the development of core vocabulary lists to aid vocabulary selection for children with special needs have also tended to target high-tech AAC users (Boenisch & Soto, 2015; Trembath et al., 2007) rather than key word signers. In most studies, the definition of what is core *vs.* fringe vocabulary is somewhat arbitrary and dependent on the study methodology. Studies in which spoken language samples are collected usually use a specified frequency and sometimes commonality of words to extract items that would be considered core. The definition of commonality varies and can refer to the number of language samples in which a word was used (Banajee et al., 2003) or the number of participants who used a word (Mngomezulu et al., 2019; Trembath et al., 2007). Trembath et al. considered words to be core if they were used by at least 50% of the participants (commonality) and had a frequency of at least 0.5 per 1000 words. Mngomezulu et al. applied the same definitions in their study. In contrast, as a result of smaller language samples elicited from participants with Down syndrome, Deckers, Van Zaalen, Van Balkom, and Verhoeven (2017) adapted their interpretation of frequency to the 50 most frequently recorded words, while using the same commonality criterion of >50% participant use. It is noteworthy that the emphasis of key word signing is very different from the spoken language used without sign, in that it supports the information-carrying concepts in a sentence (usually nouns, pronouns, verbs, and adjectives) with manual signs (Dark, Brownlie, & Bloomberg, 2019). In contrast, core vocabularies based on spoken language samples contain a large amount of function or structure words, such as conjunctions, auxiliary verbs, and articles (Banajee et al., 2003; Boenisch & Soto, 2015; Trembath et al., 2007).

The size of and time over which language samples have been recorded also varies considerably across studies, with sizes ranging from 100 to 3000 words per participant (Deckers et al., 2017; Mngomezulu et al., 2019; Trembath et al., 2007); and time ranging from 1 to 7 h, over the course of 2–6 days. The transition to primary school is a social process that involves changes, actions, and interactions, unfolding over the course of the full school year (Villeneuve et al., 2013); therefore, a more longitudinal approach is required to ensure that the key word signing vocabulary needs of all communication partners are captured as they evolve in the first year of school. Finally, with the exception of Deckers et al. (2017), who took language samples from children with Down syndrome (including spoken and signed vocabulary), all other participants in the aforementioned studies were typically developing and therefore these studies were not designed to accommodate the needs of children with Down syndrome.

The goal of the current study was to develop a core vocabulary of Lámh signs that would facilitate successful communication between children with Down syndrome and their communication partners in the first year of mainstream primary school. Although core vocabulary is usually considered to be a set of words that can be used across a range of contexts, in keeping with Dark and Balandin (2007), the current study utilizes a setting-specific approach, in that it is school focused, even though the aim was to address children's vocabulary needs in a range of contexts within that setting. The following research questions were addressed: (a) Based on the criteria of frequency and commonality, what Lámh signs can be recommended to form a core key word signing school-based vocabulary, for use with children with Down syndrome in their first year of mainstream primary school? (b) What words, for which there is currently no Lámh sign, were recommended for inclusion in the core vocabulary? (c) How does the recommended core school-based vocabulary compare to that included in the current Lámh training offered to schools?

Method

Participants

A speech-language pathologist and four key groups contributed to the development of the vocabulary: (a) students with Down syndrome aged 5;3–6;2 (years; months) in their first year of mainstream primary school, (b) their teachers, (c) their special needs assistants (SNAs), and (d) their peers, aged 4;9–5;7 (also in their first year of primary school). There were 28 participants in total: six with Down syndrome, five teachers, eight SNAs, and nine peers. Demographic information for each participating group is provided in Table 1.

Participants with down syndrome

The specific inclusion criteria for the participants with Down syndrome were: (a) a Lámh user at the time of recruitment (defined as an individual who understood and used at least three Lámh signs and whose family had been exposed to Lámh through previous speech-language therapy), and (b) enrolled to start their primary education in a mainstream

Table 1. Participant demographic information.

Participants	Age (years;months)	Sex	Lámh training completed
With Down syndrome			
1	5;03	F	N/A
2	5;09	F	–
3	5;10	F	–
4	5;08	F	–
5	6;02	M	–
6	5;03	F	–
Peers			
1.1	5;02	M	N/A
1.2	5;05	F	–
1.3	4;09	F	–
2	5;04	F	–
3.1	5;04	F	–
3.2	5;07	F	–
4	5;01	F	–
6.1	4;11	F	–
6.2	4;09	F	–
Teachers			
1	N/A	F	Module 1
2	–	F	Module 1
3	–	F	Module 1
4	–	F	Module 1
5	–	F	Module 1
Special needs assistants			
1	–	F	Module 1, Module 1 add-on
2.1	–	F	Module 1
2.2	–	F	None
3.1	–	F	None
3.2	–	F	Module 1
3.3	–	F	None
4	–	F	None
5	–	F	None

Note. M: male; F: female. Participants 4 and 5 were in the same class; Peer 4 was their corresponding peer. Peers coded as 1.1, 1.2, 1.3 indicates that they are the peers of Participant 1 with Down syndrome. Similarly, special needs assistants coded as 3.1, 3.2, 3.3 are those working with Participant 3 with Down syndrome.

school in September 2019. Parents of potential participants were recruited through Down syndrome Ireland (an organization offering support and services to people with Down syndrome in Ireland) before the school year began; eight consented to their children taking part; however, two children were planning to attend special rather than mainstream schools (a special school caters specifically to students with special educational needs due to learning difficulties, physical disabilities or behavioral problems) and were therefore excluded, for a total of six participants with Down syndrome from five participating schools (two of the participants were in the same class). These participants completed an assent form before taking part in the study. The form was read aloud to the children and had picture supports. Assent was given by ticking a box at the end of the form.

Teachers and special needs assistants

Following consent from the parents of participants with Down syndrome, the principal of each school was informed of the study and to recruit the teachers and special needs assistants. Each teacher with a participant with Down syndrome in their class ($n = 5$) and each special needs assistant working with a participant with Down syndrome ($n = 8$), consented to participate in the study. Some participants had more than one special needs assistant.

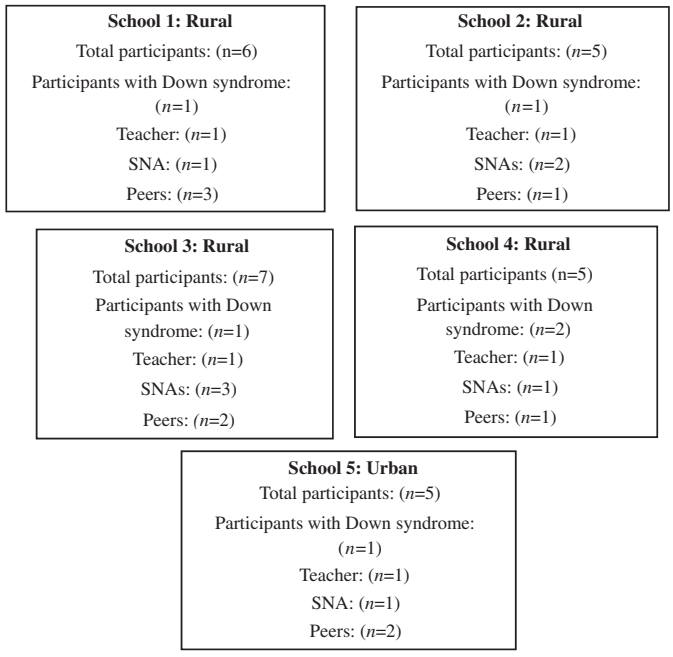


Figure 1. Distribution of participants across the five schools. *Note.* SNA: special needs assistant. Rural schools were located in villages/ areas with low population density; *urban* refers to a school located in a town.

Peers

Up to three peers of each participant with Down syndrome were recruited through their class teacher. In collaboration with the parents of the participants with Down syndrome, and parents of other children in the class, nine peers were identified to take part across the five schools. Parents provided written consent, and participating peers assented verbally.

Setting

The study took place across five mainstream primary schools. Figure 1 shows the distribution of participants across the five schools. Interviews at the first three time points took place in a quiet space within each school. As a result of the Covid-19 pandemic, interviews at the fourth and final time point took place remotely via Zoom.

Research design

Central to the research design was ensuring that the voices of the participants with Down syndrome (who are the central key word signers) would be heard and reflected in the development of the school-based Lámh vocabulary. Given the dual role of key word signing in supporting both expressive and receptive language (Rombouts et al., 2017), it was also essential that the vocabulary requirements of school communication partners were accounted for. In keeping with strategies outlined by Dark et al. (2019), the procedures for the current study involved the second author (hereafter referred to as the experimenter) (a) conducting assessments of the environment through school-based observations, (b) asking multiple informants by interviewing indirect stakeholders (teachers, SNAs, and peers), (c) and including information

from primary sign users themselves (direct stakeholders - participants with Down syndrome). The inclusion of each of these stakeholders is also in keeping with "the who" of Schlosser's social validation of interventions in AAC (Schlosser, 1999).

To facilitate the active contribution of the participants with Down syndrome, the mosaic approach was used. This is a multi-method, participatory approach that focuses on children's lived experiences (Clark, 2005), and the elements included here were participant-led tours and photography. In all interactions between the experimenter and the participants with Down syndrome, a total communication approach was used. This meant that where there were appropriate Lámh signs available (that is, signs that would have enhanced/facilitated more effective communication within the total Lámh vocabulary) the experimenter used them with accompanying speech. In addition, spoken language, Lámh, vocalizations, and non-verbal behaviors, such as pointing and facial expression were accepted as equally valid forms of communication (Fargas-Malet, McSherry, Larkin, & Robinson, 2010).

The study was approved by the social research ethics committee of University College Cork and took place in the 2019/2020 school academic year. Ethical approval did not include permission to audio record children who were not participating in the study; therefore, transcriptions were carried out in real-time.

Researchers

The research was conducted by a qualified speech-language pathologist (the second author) under the supervision of the first author. Three additional speech-language pathologists assisted with the procedural fidelity of the work. Two of the speech-language pathologists were practicing for more than 3 years and were qualified Lámh tutors. The third speech-language pathologist was newly qualified.

Materials

To profile the language level of participants with Down syndrome, parents completed the Down syndrome Education (DSE) Vocabulary Checklists 1 and 2 (Down Syndrome Education International, 2012). The checklists (based on the McArthur Bates Communicative Development Inventories – 2nd edition (Fenson et al., 2007) account for the first 120 and second 340 words understood and used by typically developing children, respectively (Down Syndrome Education International, 2012). The checklists were chosen because they document both receptive and expressive language learning and include both key word signing and words spoken as indicators of expressive vocabulary. In addition, they document whether words are used in imitation, spontaneously, or are understood by an unfamiliar listener. Table 2 presents a summary of each participants' receptive and expressive language skills, as per their parent report.

To document the school observations, a special form was developed and used to record each observed communication attempt that took place between the participants with Down syndrome and their communication partners. The form was structured such that the experimenter could (a) note the communication partner and who initiated the communication, (b) describe the interaction and the outcome (including whether or not an Lámh sign was used), and (c) recommend signs that could potentially enhance the communication or prevent a breakdown in communication, where one occurred. Core interview questions were prepared in advance of interviewing the teachers, the SNAs, and the participating peers (see Tables 1 and 3, Supplemental Material).

Procedures

To capture the ongoing changes in vocabulary needs throughout the first year of school, data were collected at four time points: the beginning of Term 1 (September/October 2019), the midpoint of Term 1 (November 2019), the beginning of Term 2 (January 2020), and the beginning of Term 3 (April/May 2020). Each data collection point involved the experimenter visiting each school on two occasions. The first visit took place over a full day, to allow for observations and vocabulary contributions from the four groups of stakeholders, across a range of activities. The second was a 1-h long follow-up visit, which took place 1–2 weeks later, the purpose of which was to demonstrate 25 Lámh signs to the whole class. The Lámh teaching visits were included as part of the study protocol as it would have been unethical to progress through the school year identifying signs that would facilitate better communication but not share those signs with those who were in daily contact with the participants with Down syndrome. The 25 signs were chosen following an initial analysis of the data collected at that time point and

Table 2. Participants with Down syndrome: expressive and receptive language skills, Down syndrome checklist.

Checklist	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6
First 120 words						
Understands	112	73	131	125	87	105
Understands and signs	64	61	17	118	49	100
Says word in imitation	12	18	133	121	2	95
Uses word spontaneously	9	7	114	124	1	91
Understood by unfamiliar listener	4	2	91	48	0	92
Second 340 words						
Understands	237	50	259	215	76	202
Understands and signs	55	30	4	142	35	44
Says word in imitation	2	3	229	225	2	54
Uses word spontaneously	0	1	143	151	0	46
Understood by unfamiliar listener	0	0	90	19	0	61

Table 3. Extract from a completed observation protocol.

Communication partner	Initiated by	Activity description	Outcome	Lámh sign to enhance communication
Teacher/SNA	Teacher (whole class)	Morning Routine: Hang up coats, take out lunches, put bags in a box	No signs used; Participant guided by SNA to carry out the sequence of actions	COAT, BAG, BOX, LUNCH
SEN Teacher	SEN Teacher	Instruction: "*Will you put your books up on the desk?*"	No signs used	MORNING, PUT (TO), BOOKS, TABLE
SEN Teacher	SEN Teacher	Doing a jigsaw (reward for lacing work). Looking for corners "*where are those pieces, I need more*".	Signs used: SAND, YELLOW, BLUE	JIGSAW, WHERE, MORE, SAND, YELLOW, BLUE

Note. SNA: special needs assistant; SEN: special education needs.

reflected the signs that had been most frequently recommended by each group of participants. At the time of the fourth data collection point, all primary schools in Ireland were closed due to the COVID-19 pandemic. As a result, the school-based observations and participant-led tours could not take place; therefore, only adult interview data that could be collected remotely were gathered at that time.

Data collection

School-based observations. The school-based observations were carried out by the experimenter at three of the planned data collection points and each school visit was considered a single observation session, resulting in a total of 15 observations. Observations were carried out for a minimum of 2 h and included all of the routines that make up a typical day in mainstream primary school, including free play, academic work, lunchtime, as well as morning and home-time routines. While observations were documented live on the devised observation record forms, the experimenter reflected on her sign recommendations after the process was completed, and made changes if she deemed an alternative sign to be more appropriate. Table 3 presents an extract from a completed observation record form.

Participant-led tours. In keeping with the mosaic procedure outlined by Clark and Moss (2005), the focus of the participant-led tours was to ask what was important in different locations around the school and document responses through the use of notes and photographs. The tours took place at one designated time in the school day, or as part of movement breaks throughout the day. The participants with Down syndrome were introduced to the concept of the tours, using simple spoken instructions supported with Lámh signs and a visual schedule (Allen, Schlosser, Shane, & Brock, 2017). The experimenter followed the child's lead, and at each stop on the tour asked, *Show me what you like here*. This was followed by the instruction *Let's take a picture*. The degree of independent participation varied, depending on the participant's needs and level of ability. In some cases, participants were accompanied by their SNA, who made comments on where the child brought the experimenter or the objects they chose to play with. In other cases, the participant brought the experimenter to a place or item of interest. Places and items of interest included hopscotch and obstacle course markings in the schoolyard, as well as a weather chart and a tablet in the classroom. The goal was to capture a minimum of five pictures on each guided tour across at least three environments but this was not prescriptive and varied depending on the participant's interests.

In addition to the photographs, the experimenter also made field notes documenting other observations about the place, activities, and items shown by the participants with Down syndrome. The photographs and notes were then compiled as a complete record of each tour. Based on each tour record, the experimenter then documented any relevant Lámh vocabulary. A total of 12 participant-led guided tours were carried out, two for each of the six participants with Down syndrome. Tours were not carried out at the first or final data collection point. The initial priority was to meet the participants with Down syndrome and build rapport, and it was therefore not appropriate to begin tours immediately. School closure prevented the final tours from taking place.

Interviews with teachers and SNAs. Teachers and SNAs contributed signs to the Lámh vocabulary through semi-structured interviews. With the exception of one teacher who was on maternity leave for the final interview, each teacher was interviewed four times (19 interviews). One special needs assistant from each of the five schools was also interviewed at each of the four time points (20 interviews). All interviews were audio-recorded.

The interviews covered a range of topics relating to the use of Lámh, including learning and using signs as well as barriers and facilitators to using Lámh within a school environment; however, for the purpose of this study only the questions that specifically addressed vocabulary were analyzed. In-person interviews were between 10 and 45 min long, while the final virtual interviews lasted up to 90 min. All teacher/SNA questions, including those designed to generate Lámh vocabulary at each data collection point, are provided in Tables 1 and 2 in the Supplemental File. Questions primarily focused on what signs the teachers and SNAs were using themselves, what signs they would find useful to aid their communication in different contexts, and what signs they think would be useful to facilitate more effective communication between participants with Down syndrome and their peers.

Interviews with peers. Semi-structured interviews were also used to generate sign recommendations from the peers of

Table 4. Data extraction from teacher interview.

01	Speaker	*So even like, I suppose we do know finished but things like y'know get your lunchbox, y'know*	FINISH, TO GET, TO YOUR, LUNCHBOX
02			
03			
04			
05	Interviewer	*Ya*	TIDY UP, TO
06	Teacher	*Tidy up, amm I'm trying to think of other ones*	COME IN
07	Interviewer	*It's tough to think off the top of your head*	WE, GO, TO
08	Teacher	*Ya, like you know tidy, like y'know come in we're going*	OUTSIDE
09		*outside, line up*	LINE UP, TO

participants with Down syndrome; however, there were several differences between the interview protocol used with children *vs.* that used with the teaching staff. As recommended by Curtin (2001), in an attempt to balance the adult-child power relationship the researcher and the peers sat at the same level on child-size chairs or on the floor. Rapport was developed through playing a game that the child selected and by beginning each interview by discussing the peer's own interests (Spratling, Coke, & Minick, 2012). In addition, a puppet character, Patch the dog, was introduced at the second interview. Puppets are a widely used tool in education settings and research suggests that they can help to put children at ease, and thus increasing and improving communication (Kröger & Nupponen, 2019).

Nine peers were interviewed three times across the five schools (27 interviews). Interviews took place between the experimenter and each peer in an open space, removed from the busy classroom environment. All interviews were audio-recorded and ranged in length from 5 to 18 min. The first interview was exploratory and allowed the experimenter to meet the peers for the first time and get an overall sense of their understanding of Lámh. None of the peers had any prior exposure to Lámh before entering the school. At the second and third interviews, peers were encouraged to adopt the role of Patch's Lámh teacher. This was prompted by Patch asking them questions about learning Lámh and using Lámh in school. All interview questions are reported in Tables 3 and 4 in the Supplemental Material; however, as was the case with the adult interviews, only responses that focused on generating vocabulary were analyzed.

Data extraction and analysis

The goal of the data extraction process was to compile the vocabulary recommended by each group into a single format. Signs recommended through observations were removed from each observation form and transferred to a master file. Similarly, the sign recommendations from the guided tours were compiled into one master file. Interviews with the teachers, SNAs, and peers were transcribed verbatim and analyzed line by line to record all signs recommended during each interview. Subsequently, these were transferred to a master file for each of the groups. A worked example of data extraction from an interview with a teacher/special needs assistant is shown in Table 4, and an example of peer interview data extraction is shown in Table 5 in Supplemental Material.

When extracting signs the following rules applied: (a) Different forms of a word were coded as one word, using the format in the published Lámh sign books. For example, "Jumping", "Jumped", and "Jumps" were coded as "Jump to"; (b) vocabulary items that referred to a specific game (e.g., "Duck Duck Goose") were coded as a single recommendation, rather than three separate words; (c) references to a category of words (e.g., "Colors") were not coded as a single sign recommendation; rather, only individual signs (e.g., RED) within a given category were included; and (d) words recommended for which there is currently no Lámh sign were analyzed separately.

The criteria used to separate the total data set into core and fringe vocabularies were frequency and commonality. The total frequency of each sign was calculated by summing the number of times it was recommended across each of the groups. Signs were then ranked in order of frequency from highest to lowest. Commonality referred to the number of groups that recommended a given sign, such that a commonality score of 5 indicated that a sign was recommended by all of the groups who contributed to the vocabulary. Signs were then ranked according to their commonality score. Lámh signs were considered to be part of the core vocabulary if they had a total frequency greater than or equal to 5 ($\geq$5); that is, if a sign was recommended at least 5 times, regardless of group and a commonality score greater than or equal to 3 ($\geq$3). This is in keeping with previous studies where $>$50% participant use was applied (see Deckers et al., 2017; Mngomezulu et al., 2019; Trembath et al., 2007). The signs that did not fulfill these criteria were classified as fringe vocabulary.

Procedural fidelity/rigor

To ensure data credibility, methodological and data triangulation were used. Data triangulation was achieved through the range of stakeholders that contributed to the vocabulary over the course of the year. Methodological triangulation was addressed through the use of multiple methods of data collection; that is, observations, interviews, and participant-led tours. Transparency was addressed through the detailed description of the research process, data collection, extraction, and analysis. In addition, the experimenter maintained a reflective journal throughout the process documenting what, as well as how and why each research element was completed (Tuval-Mashiach, 2017). Two speech-language pathologists (who were also Lámh tutors) attended the second and third planned school observation visits. They completed the observation protocol independently and recommended signs accordingly. There was 100% agreement between the experimenter and the SLPs, indicating confirmability of the signs

Table 5. Recommendations for a core school-based Lámh vocabulary.

Lámh sign	Commonality score	Total frequency	Lámh sign	Commonality score	Total frequency
PLAY, TO	5	82	NEXT	4	12
LOOK, TO	5	81	FRIEND	4	10
SIT, TO	5	71	WHERE?	4	10
GO, TO	5	50	BOY	4	12
YOU	5	46	DIFFERENT	4	10
GOOD	5	41	READY	4	10
WHAT?	5	36	HOUSE	4	10
TIME	5	35	WITH	4	10
THANK YOU	5	32	FATHER	4	10
BOOK	5	31	TEACHER	4	9
HELLO/HOW ARE YOU?	5	27	QUICK	4	9
WANT, TO	5	26	OK	4	8
I/ME	5	25	COME, TO	4	8
GIRL	5	25	DOLL	4	8
BOX	5	25	SILLY	4	8
BLUE	5	23	HAPPY	4	7
SHOW, TO	5	21	THIRSTY	4	7
TABLE	5	19	DOWN	4	7
JIGSAW	5	18	BIRTHDAY	4	6
GAME	5	17	BREAK, TO	4	6
PLEASE	5	15	GOODBYE	4	6
SCHOOL	5	13	IN	4	5
TOY	5	12	BUILD, TO	4	5
MOTHER	5	11	SUN	4	5
MUSIC	5	11	MORE	4	5
NAME	5	11	COLOR	4	5
BALL	5	10	BAG	4	5
LIKE, TO	5	10	AGAIN	3	27
BIG	5	10	YELLOW	3	22
FIND, TO	5	10	GREEN	3	20
FOOD	5	9	DOG	3	17
TODAY	5	9	SAD	3	15
BRICK	5	9	DRINK, TO	3	14
ON	5	8	HAND (BODY PART)	3	12
TREE	5	8	WASH, TO	3	11
SHEEP	5	7	SING, TO	3	10
LUNCH	4	49	SLEEP, TO	3	10
FINISH, TO	4	42	CAT	3	10
NO	4	41	WALK, TO	3	10
WAIT, TO	4	39	DAY	3	9
LISTEN, TO	4	37	SLOW	3	9
WORK, TO	4	35	TEDDY	3	9
STOP, TO	4	30	WHO?	3	9
CATCH, TO	4	29	SAND	3	9
COAT	4	24	PE	3	8
RUN, TO	4	24	READ, TO	3	8
RED	4	24	DRAW, TO	3	8
TOILET	4	23	HIDE, TO	3	7
HOME	4	21	BABY	3	7
JUMP, TO	4	20	GIVE, TO	3	7
EAT, TO	4	19	SAY, TO	3	7
STORY	4	19	WE	3	6
OUT	4	18	FARM	3	6
TIDY UP, TO	4	18	APPLE	3	6
CHAIR	4	17	CLOTHES	3	6
MORNING	4	17	DANCE	3	6
OPEN, TO	4	16	DOOR	3	5
YES	4	16	HUNGRY	3	5
STAND UP, TO/UP	4	16	COW	3	5
SAME	4	16	HAT	3	5
HELP, TO	4	15	MAKE, TO/ DO, TO	3	5
TURN	4	15	ORANGE	3	5
SMALL	4	13	PLAY DOUGH	3	5
FALL, TO	4	13	PUT, TO	3	5
BE CAREFUL	4	12	PINK	3	5
SORRY	4	12	PURPLE	3	5

recommended. Confirmability of the remaining data was addressed through an additional SLP who recommended signs based on transcripts of 25% of randomly selected interviews and guided tours. This SLP was a new graduate and less experienced in choosing relevant signs than the experimenter. On initial inspection of the data, she tended to suggest vocabulary covering the same topic as the experimenter but at a level that was too advanced for the children with

Table 6. Recommendations for a core school-based Lámh vocabulary: words with no Lámh sign.

Word with no Lámh sign	Provisional Lámh classification	Commonality score	Total frequency
Line up, to	Action	4	20
Outside	Object	4	13
Duck Duck Goose	Object	4	12
Watch, to	Action	4	7
Yard	Object	4	5
Be Able, to (Can)	Action	3	6
Favourite	Modifier	3	5
Well Done	Social	3	5

Down syndrome in the study. Although further training was provided to address this situation, for the purposes of transparency, the agreement was calculated for these early recommendations. Overall the aggregate total agreement for this data was 85.32%.

Results

The first research question addressed what signs could be recommended to form a core key word signing school-based vocabulary for use with children with Down syndrome in their first year of mainstream primary school. The total number of sign recommendations was 2557; following the removal of duplicates, 305 different signs were recommended across all of the stakeholder groups. The frequency of signs ranged from 1 to 82, and 239 signs (78%) had a total frequency of <10. Thirty-four signs (11%) had a total frequency of between 10 and 20; 16 (5%) between 20 and 30; seven (2%) between 30 and 40, and six (2%) between 40 and 50. Only three recommended signs (1%), had a total frequency higher than 50: PLAY, LOOK, and SIT. The rank ordering of sign frequency for all signs with a frequency greater than or equal to 5 (≥ 5) can be seen in Table 6 (Supplemental Material).

Of the 305 recommended signs, 36 (12%) had a commonality score of 5. These signs were recommended a total of 894 times, accounting for 34% of the 2557 signs in the overall data set. The word classification breakdown was 16 object signs, eight action signs, four modifier signs, four social signs, and four people signs. Among the remaining recommended signs, 55 (18%) had a commonality score of 4, 58 (19%) a commonality score of 3, 74 (24%) had a commonality score of 2, and 82 (27%) had a commonality score of 1. A list of the recommended Lámh signs, with a commonality score of 3 (≥ 3), is presented in Table 7 in the Supplemental Material.

Applying both the frequency and commonality criteria resulted in 132 signs for inclusion in the core vocabulary. These signs accounted for 83% of the total number of signs recommended by all stakeholders. The breakdown according to sign classification was as follows: 36 action signs (27%); 27 modifier signs (20%); 46 object signs (35%); 10 people signs (8%); and 13 social signs (10%). The full list of Lámh signs in the core school-based vocabulary is presented in Table 5, along with a record of total frequency, and commonality score. The remaining 173 signs, classified as fringe vocabulary, are presented in Table 8 in Supplemental Material.

The second research question addressed what words were recommended for inclusion in the vocabulary for which there is currently no Lámh sign available. The total number of recommendations was 283; after the removal of duplicates, there were 140 different words with no Lámh sign recommended for the school-based vocabulary. Of these 140 words, 79 (57%) had a frequency of one, indicating that they were only recommended once throughout the four data collection points; and 92 (66%) had a commonality score of 1, indicating that they were recommended by only one of the stakeholder groups. To establish what is core, frequency (≥ 5) and commonality (≥ 3) criteria were applied. Only eight words met the inclusion criteria (see Table 6) and included three action words, three object words, one modifier, and one social word.

The final research question asked how the recommended core school-based vocabulary compares to that included in the currently funded Lámh training offered to schools in Ireland, the Lámh Module 1 course. When compared, the recommended core vocabulary was larger than the vocabulary set included in the Module 1 training (100 signs *vs.* 140 words/signs). The two sets of vocabulary had 55 signs (39%) in common. Of the remaining 85 words from the recommended school-based vocabulary, 77 are taught in more advanced training (55%) and the remaining eight (6%) are those for which there is currently no Lámh sign. Looking at how the signs were classified, the proportion of social signs (10 *vs.* 11%), people (7 *vs.* 10%), and modifiers (20 *vs.* 16%) were relatively similar across the two sets of vocabulary, the first number in each comparison refers to the recommended vocabulary and the second to the Module 1 signs. The main differences were in the proportion of object signs (35 *vs.* 46%) and action signs (28 *vs.* 17%). While the current Module 1 includes a higher proportion of object words, the recommended school-based vocabulary has a greater focus on action words.

Discussion

The current study provides new insights into the complex process of vocabulary selection for AAC users in school, specifically, children with Down syndrome who use Lámh, the key word signing system in Ireland. The aim was to recommend a core vocabulary of Lámh signs that would facilitate successful communication in the first year of mainstream primary school, given the need for inclusive education practice and the interaction and academic demands inherent in formal education.

Recommended signs to form a core school-based key word signing vocabulary

After applying frequency and commonality criteria to the total data set, a core vocabulary of 140 items was established, with each of the five Lámh word classifications represented. These results are in keeping with the estimation that core vocabulary can account for up to 80% of words used within a communicative context (Deckers et al., 2017).

Although over 2851 vocabulary recommendations were made by the stakeholders (445 different words/signs), the total frequencies of these 140 core vocabulary items accounted for 77% of the total number of words recommended to the school-based Lámh vocabulary. Similarly, the 263-word core vocabulary outlined by Trembath et al. (2007) accounted for 79.8% of their total sample, and the 200 words put forward by Boenisch and Soto (2015), accounted for 80% of their total sample. Despite methodological differences between the current study and others, in which core vocabulary has been determined, the current results are in keeping with expectations outlined by Deckers et al. (2017).

In terms of the proportion of verbs, the findings are similar to those reported by Boenisch and Soto (2015): 28 *vs.* 26%. This was also the case for adjectives and adverbs: 20 *vs.* 18%. In stark contrast to previous studies where nouns accounted for only 11% (Trembath et al., 2007) and 7% (Boenisch & Soto, 2015), nouns accounted for a significant 42% of the recommended school-based vocabulary. This reflects the role of key word signing in supporting the content words in a sentence, rather than the grammatical markers, articles, or prepositions, and is one of the crucial differences between key word signing and spoken language (Dark et al., 2019). Content words, such as nouns, verbs, adverbs, and adjectives, are highly referential; are more in keeping with the expressive language skills of many young children with Down syndrome; and can be used in isolation for labeling and describing. In contrast, in spoken language, the most frequently used words tend to be function words (Witkowski & Baker, 2012), which often need to be combined with other words to create meaning (Boenisch & Soto, 2015). The frequency of function words is clearly reflected in core vocabulary studies for high-tech AAC users that employ language samples as the primary tool for data collection (see Banajee et al., 2003; Boenisch & Soto, 2015; Trembath et al., 2007). Additionally, unlike high-tech AAC systems that are designed for use only by the person who needs additional communicative support, the aim is that key word signing will be used by both parties in the communicative process, thereby supporting both receptive and expressive language. It is significant that the individual modeling the signs is also speaking the full sentence, so that even if content words are the main signing focus, children are also exposed to function words to facilitate their overall comprehension. The current study emphasizes the differences in the type of core vocabulary prioritized when key word signing is the method of AAC employed.

Frequency

With respect to sign frequency, the most frequently recommended sign was PLAY, representing the importance of play within primary school settings. Not only does play provide important opportunities for learning social skills and building relationships, but it is also a source of joy, both inside and outside the classroom (Moore & Lynch, 2018). Additionally, in recent years there has been a more formal acknowledgment of the role of play in facilitating learning in the junior infants (first year of primary school) curriculum. In 2009, the Aistear play-based curriculum was introduced in Ireland to address the educational needs of children aged 0–6, in an attempt to move away from the more historical formal learning curriculum (Gray & Ryan, 2016). Typically this involves setting up four to five play areas in the classroom that may include physical, creative, socio-dramatic, and small-world play. Other frequently recommended action signs, which included words, such as LOOK, SIT, GO, FINISH, WAIT, WORK, TIDY UP, STAND UP, WRITE, and LISTEN, are also in keeping with a school context. While these verbs may appear teacher- or adult-focused, particularly in their root form, they often covered a range of communicative functions. For example, GO and FINISH were also frequently used by children in play activities, such as *Ready, steady, go!* The sign LOOK served to facilitate joint attention, an essential pre-requisite for successful signing (Clibbens et al., 2002). The action signs OPEN and HELP could be used by participants with Down syndrome to make requests; and BUILD, DRAW, FALL, and HIDE could facilitate communication between peers when playing together. With regard to frequently recommended objects, many items were again readily associated with a school environment or routines. Signs, such as COAT, BAG, BOX, BOOK LUNCH, TOILET, PE, and HOME were unsurprising and highlighted the role of the setting in determining core vocabulary (Dark & Balandin, 2007).

The most frequent modifier signs were also readily associated with school: GOOD, MORE, and the colors RED and BLUE. Under the subject area of visual arts education, color is part of the junior infants school curriculum (NCCA, 1999). Based on observations, the use of color words was documented during stories, songs, numeracy activities (such as sorting), and as part of instruction in the classroom. In addition, color words were a common topic of conversation between the children and were used to describe toys, clothes, and other items of interest. Other modifiers included those that expressed physical needs (HUNGRY, THIRSTY, SICK) and emotions (HAPPY, ANGRY, SAD). In contrast, frequently recommended social and people signs tended to be more general, in that they could be used by Lámh users of all ages, across a range of environments (e.g., HELLO, THANK YOU, NO, AND, WHAT, WHERE, WHO, EXCUSE ME, YOU, I/ME, and GIRL). Interestingly, YES and NO accounted for only 2% of the recommended vocabulary, compared to findings by Deckers et al. (2017), for example, where YES and NO alone made up 19% of the total word sample from which their core vocabulary was chosen. Additionally, in the current study NO had more than double the sign frequency than YES, a preference that may be explained by its association with discipline and classroom management. NO was also recommended in the context of participants with Down syndrome taking on a more active rather than passive role and being more assertive in play situations.

Commonality

In the current study, both frequency and commonality were chosen as metrics of inclusion in keeping with the idea that vocabulary that was recommended by different groups would reflect a broader perspective; however, the frequency

cut off of five or more (≥5) captured 88% of the words which were most commonly recommended. Therefore, the frequency criterion alone did in fact encapsulate the majority of signs recommended, a result that highlights the interdependent nature of these two constructs.

Differences included a higher focus on nouns with respect to commonality *vs.* a greater focus on verbs in relation to frequency. Nouns recommended by all groups reflected the importance of vocabulary that is motivating (e.g., GAME, BALL, and MUSIC) and can be reinforced with available resources, such as the Lámh-a-song signing DVD. As outlined by Dark et al. (2019), the importance of having access to engaging, age-appropriate resources is one of the key elements of a successful signing environment. In the context of school one might expect a predominance of question words; however, WHAT was the only question with a commonality score of 5. In relation to the language of instruction (Blank, Rose, & Berlin, 1978), "What" is a level one (or least abstract) question, characteristic of the language used in an early education environment. Other commonly recommended action and social signs, such as PLAY, LOOK, SIT were captured by the frequency criterion.

Words for which there is currently no Lámh sign

Only eight words for which there is currently no Lámh sign met the inclusion criteria for core vocabulary. The most frequently recommended vocabulary item was a *lineup*, which is unsurprising, given its inherence in school order and communication. Other recommended words referred to the outdoor space of the school, and it was notable that different words were used to refer to the same space (*outside, yard, playground*). Accordingly, a sign that could cover all three referents would be advantageous. The phrase *Well done* was also recommended and is important in recognition of children's achievements and effort. Words that referred to specific games played in the school yard also featured in the list of words with no Lámh sign. *Duck Duck Goose*, the title of a game similar to tag, was observed at all five schools and was recommended 12 times by the four contributing groups. While one could argue that some of these examples could be substituted by Lámh signs that currently exist (e.g., OUT/GARDEN for *outside/yard;* GOOD and MAKE/DO for *well done*; and DUCK, CATCH, RUN, or JUMP for *Duck Duck Goose*), for vocabulary to be used successfully it must accurately reflect a person's age and group membership (Trembath et al., 2007), and these signs may not be specific enough to be accepted. While these eight words provide a starting point for the development of new Lámh signs for mainstream primary schools, further analyses of those that did not quite meet our inclusion criteria for core vocabulary may also prove useful. The finding that only these eight words were recommended as core lends support to the argument that key word signing systems, such as Lámh are sufficient to support the receptive and expressive language skills of children with Down syndrome at this age; however, as children's language skills develop this may no longer be the case. Therefore, it is important that devised systems are frequently revised to ensure that relatively simple iconic signs are available and that they reflect children's expanding skills as well as the ever-changing nature of a living language.

School-based core vocabulary compared to the Lámh module 1 vocabulary

Comparing the recommended core school-based vocabulary to the vocabulary included in the Lámh Module 1 course provides insight into whether the training most commonly accessed by school staff is accommodating the vocabulary needs of children with Down syndrome and their communication partners throughout the school day. Dark and Balandin (2007) emphasize the importance of providing AAC users with a core vocabulary that is context-specific. Initial findings from the current study show that 100 signs are not sufficient to meet the communication needs of children in their first year of primary school, and relative to the current Module 1 course, a higher proportion of action and modifier signs are required. Conversely, a lower proportion of core vocabulary object signs are included (35 *vs.* 46%), perhaps driven by the setting-specific nature of the study. In relation to vocabulary overlap, only 55 (39%) of the signs recommended as core are included in the Module 1 training and 79 (56%) are part of more advanced training. In addition, 65% of the object signs recommended as core are not included in Module 1. Words, such as LUNCH, PE, and TEACHER are clearly inherent in school communication but are not, understandably, part of a more generic course. Words related to specific play activities were also considered important in school (PLAY-DOUGH, STORY, JIGSAW, TOY, BRICKS, TEDDY, and DOLL) and one would not expect that these items would be part of a course designed to meet the needs of a broad age range of Lámh users. In contrast to the proportionality of object signs, the need for more core vocabulary action signs (28 *vs.* 17%) would seem somewhat intuitive, as children's day in school is defined by doing, and therefore experiencing, different activities to learn; the importance of giving and understanding instructions in the classroom cannot be overstated.

The need for a slightly higher proportion of core vocabulary modifier signs (20 *vs.* 16%) could be attributed, at least in part, to the specific need for color signs in school. The lower proportion of people signs (7 *vs.* 10%) may be driven by the reduced number of people children are exposed to in a school setting. Finally, the almost equal proportion of social signs recommended across vocabularies (10 *vs.* 11%) is perhaps unsurprising, as social signs are required in many different contexts. Interestingly, core social signs not part of Module 1 training included PLEASE, SORRY, OK, and READY, all of which played a particularly important role in the everyday communication between the participants and their peers in school. Overall, it is clear that the current Module 1 training does not adequately meet the vocabulary needs of children and staff in promoting more effective inclusion in mainstream schools. Given that teachers often take on the role of key word signing instructor for the class, they need

to prioritize the most relevant school-focused vocabulary to carry out this role effectively.

Clinical implications

The findings of the current study have implications for both Lámh users and the network of people and professionals that support them in attending mainstream primary school. Increasingly, children with Down syndrome who use key word signing attend their local primary school; however, limited knowledge and use of key word signing in early education settings have created considerable barriers to their inclusion (Cologon & Mevawalla, 2018). For pupils who use key word signing, effective, meaningful communication is contingent on their communication partners' acceptance and knowledge of signing as a form of AAC. The development of a core, school-centered, key word signing vocabulary, could facilitate knowledge of relevant signs for early educators as well as school peers, increase the likelihood that signs will be used in school, facilitate better access to the curriculum and participation, and promote acceptance among all those interacting with Lámh users.

Furthermore, the vocabulary recommended in this study could inform school-specific key word-signing training and resources. Currently in Ireland, funding is only available for teachers to train in a course that is not specific to the school context. Without appropriate training in the relevant vocabulary for all staff working with these children (including SNAs and special educational needs teachers), key word signing will not be effective as an AAC strategy. The finding that not all recommended items currently have a devised sign, also highlights the importance of ongoing sign development. Lastly, the methods used in the current study could (a) be applied or adapted to enable practitioners to take a systematic approach when identifying core vocabulary for children they work within different contexts, and (b) supplement other vocabulary identification strategies (such as inventories and checklists) currently used in practice.

Limitations and future directions

In the current study, data collection varied for each of the stakeholder groups, involving a combination of observations, interviews, and participant-led guided tours. While this facilitated the participation of a diverse range of contributors, it resulted in a less established methodology for core vocabulary data analysis, as well as some potential biases. The experimenter recommended the largest number of different signs, which was likely to be driven by the fact that she was a speech-language pathologist with advanced Lámh training, had knowledge of both the receptive and expressive benefits of key word signing and viewed each communication attempt from the perspective of both communication partners. The nature of the participant-led tours was that the vocabulary context was generated by the participants with Down syndrome; however, there was a level of interpretation required on the part of the experimenter. For the peers of the participants with Down syndrome, questions relating to Lámh and language use involved a level of meta-linguistic skill, in that they were required to talk about and analyze language use, removed from a specific context (Chaney, 1992). Given the age of the peers and their limited metalinguistic skills, it is possible that their vocabulary choices were influenced by their most recent interactions or activities.

The current study is the beginning of research into the development of core key word signing vocabulary for use in mainstream primary schools. Further research is required to establish how best to implement this vocabulary in schools, develop appropriate resources to reinforce the vocabulary, and formulate a school-centered training programme for Lámh users and their communication partners. We envisage the use of a behavior-change intervention, using the COM-B model (Capability, Opportunity, and Motivation) (Michie, van Stralen, & West, 2011; Rombouts et al., 2017) to establish the components necessary for a school-centered training program to be effective and ensure continued implementation of Lámh in mainstream schools. It would also be beneficial to carry out this study on a larger scale and investigate the vocabulary needs of older sign users as they progress through primary school and on to secondary level education. This is particularly pertinent in light of the fact that many children with disabilities, who initially attend mainstream schools, turn to special schools in later years (Lightfoot & Bond, 2013).

Conclusion

This study highlights the importance of an appropriate sign vocabulary to meet the communication needs of children with Down syndrome and those with whom they interact in mainstream primary school. Vocabulary selection for AAC users is widely regarded as a difficult and time-consuming task (Trembath et al., 2007), and the dual role of key word signing in supporting both expressive and receptive language presents an added layer of complexity (Dark et al., 2019). The recommendations for a school-based key word signing core vocabulary presented in this study are the result of an in-depth, multi-method investigation that took place over the course of a full school year. As such, they can serve as a reliable starting point for the network of people and professionals who support the academic and social inclusion of children with Down syndrome using key word signing as they begin their primary school education.

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