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# A scoping review of AAC research conducted in segregated school settings

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## ABSTRACT

**Background:** School education for children with severe disabilities tends to occur in restricted or segregated settings, especially for students who require augmentative and alternative communication (AAC).

**Aim:** We sought to understand the role played by AAC, especially in supporting students' academic learning and social participation in studies conducted in segregated school settings.

**Methods:** We conducted a scoping review, searching five databases, supplemented by hand, ancestral and forward citation searches of studies published from 2000 to 2020 involving compulsory school-aged students and featuring AAC. Data were extracted and summarized regarding study and participant characteristics, and key findings.

**Result:** Our search yielded 141 studies conducted in a segregated setting ( $n = 129$ ) or mixed settings ( $n = 12$ ). Most studies focused on communication skills ( $n = 69$ ); academic skills ( $n = 27$ ) and social participation ( $n = 17$ ) were addressed to a far lesser extent.

**Conclusions:** Research into students requiring or using AAC has focused on teaching communication skills and far less on academic learning and social activities of classrooms and schools. There is a need for research that extends beyond functional communication into how AAC can promote access to these key aspects of school education.

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## What this paper adds

This scoping review of the literature highlights that there is a large body of research incorporating AAC for school students with complex communication needs that has been conducted in segregated settings of special schools and units within mainstream schools. This research demonstrates that many students across grades from primary (elementary) to high (secondary) schools lack access to functional forms of AAC. The findings call into question the need for teaching functional and proficient use of AAC prior to engaging in academic learning and the social milieu of the classroom and school.

## 1. Introduction

School education for children with severe disabilities tends to occur in restricted settings, such as special schools or segregated units within mainstream schools (Agran et al., 2020; Iacono et al., 2019; Morningstar et al., 2020; Wehmeyer et al., 2020). With some exceptions, this situation pertains internationally, despite ideological and empirical support for inclusive education, whereby students with disabilities learn in the same place and alongside their peers without disability (Agran et al., 2020; Iacono et al., 2019; Morningstar et al., 2020). For many of these students, augmentative and alternative communication (AAC) (e.g., signs, communication boards and devices) offers the means to express and understand varied communication functions, and facilitate social interactions, friendships, and academic learning (Calculator, 2009), but the extent to which these benefits have been realised remains unknown.

Agran et al. (2020) identified a number of factors that contribute to placing students with severe disabilities in segregated settings in the United States (US), such as beliefs about their inability to benefit from mainstream settings because of a need for specialized and individualized instruction. Kleinert (2020) reported data to show that students who lack a formal mode of communication are at particular risk of being relegated to segregated schools or classrooms: up to 30 % of students who require alternative educational assessments lacked access to formal or systematic modes of communication, with 10 % having no mode of symbolic communication, with little evidence of increasing access as students progressed from primary (elementary) to secondary (high school) years. Yet, benefits found for other students with disability have also been found for those who rely on AAC, including increased opportunities for social interaction, access to peer models to support academic learning and positive behaviours, and development of language skills (Finke et al., 2009). Calculator (2009) argued that students with complex communication needs require functional AAC to access their potential benefits. Such access is reliant on skilled supports to determine and implement appropriate AAC options for individual students, which are best provided by speech-language pathologists working alongside general educators, special educators, family members and other stakeholders within collaborative teams (Alant et al., 2013). Unfortunately, speech language pathologists may be more available in restricted than inclusive settings (Calculator, 2009; Iacono et al., 2020), a situation that can contribute to the lack of formal modes of communication by school students with complex communication needs (Kleinert, 2020).

In exploring the role of AAC to support inclusive education of students of compulsory school age, Iacono, Goldbart, Douglas and Garcia-Melgar (2021) reviewed research conducted in school settings. They found that, within the AAC literature, few studies conducted over an approximately 20-year period occurred in mainstream schools or involved mainstream classroom peers: in fact, only around 17 % of 167 studies met these criteria. Varied aims were addressed within these inclusive school studies, but improvements in academic skills and peer interactions featured, as well as the investigation of friendships between students who used AAC and classroom peers. More than half of the studies in inclusive settings were appraised to be of high quality and included single case experimental designs (SCED) and qualitative studies. It would seem, then, that most students who use or require AAC attend segregated settings. Studies that have been conducted in inclusive school settings, although relatively few, are indicative of positive outcomes for both students who use AAC and their mainstream peers (Iacono et al., 2021).

In light of the findings from Iacono et al. (2021), the question remained as to the outcomes experienced by students who were in segregated settings for all or part of their school days, or for the purpose of the research, and used or could benefit from AAC, given they are the group with whom most research involving AAC has been conducted. The aim was to complete a scoping review of research conducted within segregated settings that involved AAC found from the larger systematic search reported by Iacono et al. (2021). Our specific aim was to explore the role of AAC and the extent to which it included supporting increased opportunities for academic learning and social participation, as had been found for those students in inclusive settings (Iacono et al., 2021).

## 2. Methods

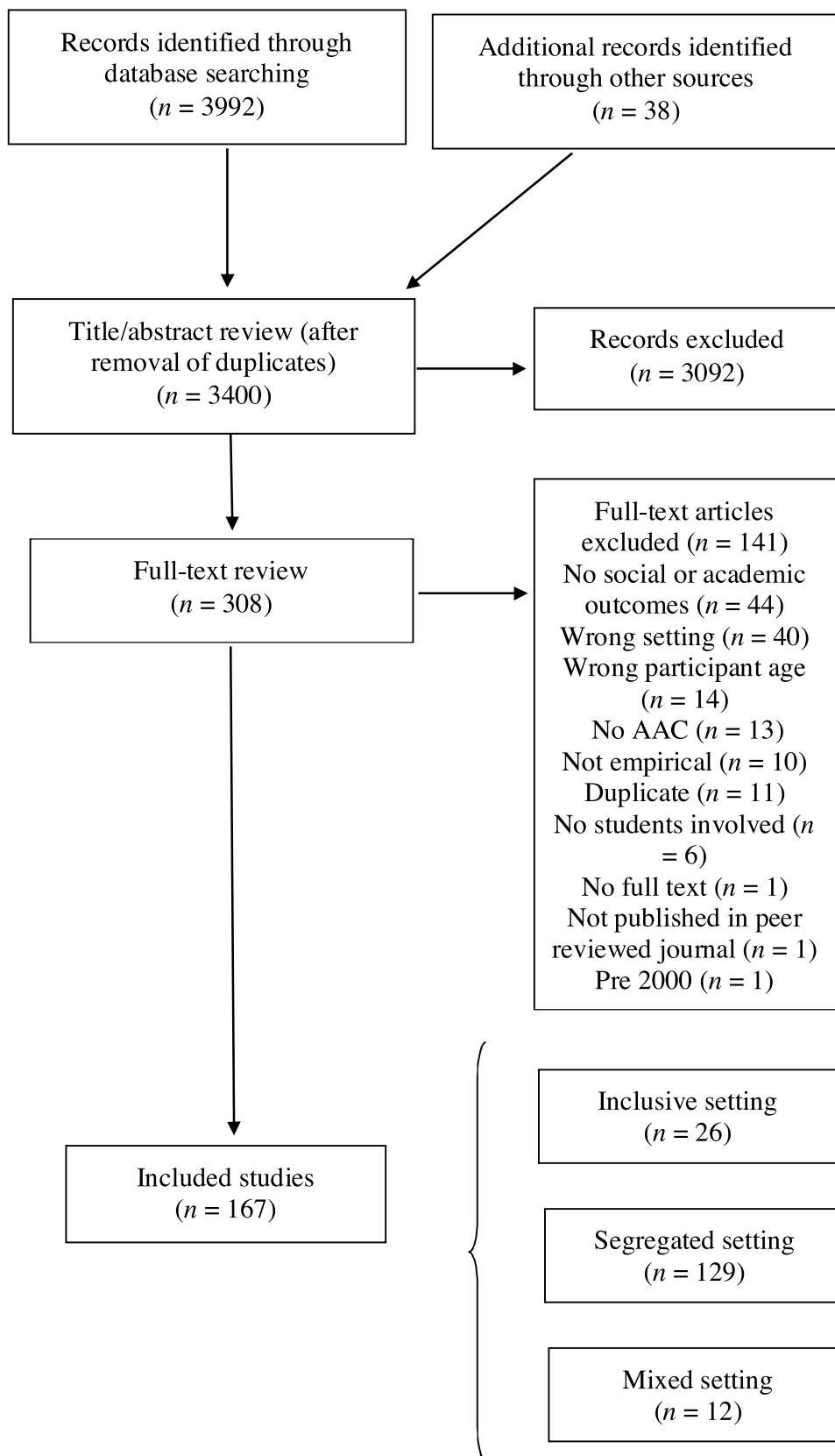
### 2.1. Search methods

This scoping review (Arksey & O'Malley, 2005) was completed in conjunction with Iacono et al. (2021). We report on studies retrieved following a systematic search, as detailed in a registered protocol (Iacono, Goldbart, Douglas & Garcia-Melgar, 2018). Five databases were searched: PsycINFO (OVID), CINAHL (UBESCO), four in ProQuest (Education Collection, Nursing & Allied Health Database, Psychology Database, & Social Science Database), LLBA, Scopus, and ERIC. Forward citations and ancestral searches were conducted in relation to studies included on the bases of the database searches and hand searches of the journal *Augmentative & Alternative Communication*. Search terms comprised the following and their variations: "AAC," "complex communication needs," "intervention," "disability," "school children," "school education." The starting publication date was 2000 with the end publication date of August 2020. Key inclusion criteria were that studies be published in a peer-reviewed journal and involve participants of compulsory school age (as per the country of the study) attending primary or secondary schools or equivalent with AAC featuring within an intervention or by participants or their peers. See Iacono et al. (2018) for the full protocol.

Title and abstract screening of database search results occurred in Covidence (n.d.). Results from ancestral and forward citations searches (conducted in Web of Science) of studies retrieved from the database search were imported into Endnote™ for screening. Screening at the title, abstract and full text levels was completed by two authors. Disagreements about inclusion and also categorization of the setting of studies were resolved through discussion.

### 2.2. Search results

The results of the search process are summarised in Fig. 1. As can be seen from this figure, of the 167 studies retrieved from the



(caption on next page)

Fig. 1. Search strategy and outcomes.

search for the larger study, 129 (77 %) were conducted fully in a special school or classroom, or a room separated from mainstream peers. In some studies, students were segregated only for the purpose of the study, but without any involvement of peers or data collection occurring within the mainstream setting. In addition, 12 (7%) were conducted across segregated and inclusive settings, referred to as mixed setting. All studies were published in English, although this was not an inclusion criterion.

### 2.3. Data extraction

Details of the 141 studies conducted in segregated or mixed settings were extracted to a table and included the following: country in which the study had been conducted, aims, participant characteristics (numbers and student gender, age, type of disability, number of peers, number of adult participants and roles), study design, and key outcomes. This information is provided in Supplementary Table S1. In addition, in order to assist with synthesizing data, categories for study aims and designs were assigned a numerical code for entry into IBM SPSS Statistics 25. Assignment of these codes was completed by one of the researchers, with another coding 28 studies (20 %), achieving agreement on 26 (93 %). Disagreements were discussed to ensure accurate application of the codes to the remaining studies. The type of AAC used by students during data collection was also categorized as unaided (i.e., no external object, usually signs), low tech (i.e., not requiring electronics or batteries, such as communication boards or books) or high tech (i.e., requiring electronics, such as iPads™ and other Speech Generating Devices), with these variables assigned a code for entry into SPSS.

## 3. Results

### 3.1. Study characteristics

Of the 141 studies included as occurring whole or in part in segregated settings, almost half were conducted in the US ( $n = 70$ , 49.6 %). The next most frequent country was the United Kingdom ( $n = 19$ , 13.5 %), followed by New Zealand ( $n = 13$ , 9.2 %), Australia, Canada and South Africa (each with  $n = 7$ , 5%), Sweden ( $n = 5$ , 3.5 %), Norway ( $n = 3$ , 2.1 %), India, Israel, Taiwan (each with  $n = 2$ , 1.4 %), five countries with only one (.7%) study (Finland, Greece, Ireland, Singapore, and Spain), and one study conducted across a number of countries.

Of the studies conducted solely in segregated settings ( $n = 129$ ), almost half ( $n = 64$ , 49.6 %) were in special schools. Of the remaining segregated only setting studies, 21.7 % ( $n = 28$ ) were in a self-contained classroom for students with disabilities, located on the campus of a mainstream school, and in 27.1 % ( $n = 35$ ), data collection occurred in a room separated from peers, but information was not provided about the type of school. For 1.6 % ( $n = 2$ ), the study was conducted during a summer program attended by students with disabilities only (Flores et al., 2012; Myers, 2007). For 6.9 % ( $n = 8$ ) of the segregated only setting studies, although students attended a mainstream setting, all data collection occurred in a room separate from their peers with no research activities occurring in students' classes. For the mixed setting studies ( $n = 12$ ), the setting for most participating students was a special school (58.3 %,  $n = 7$ ), with 25 % ( $n = 3$ ) in a self-contained classroom or unit within a mainstream school, and one in a self-contained classroom with the type of school not reported. For the studies in which students were seen across segregated and inclusive settings, results for only the segregated settings are reported here.

The frequency with which various aims were addressed is presented in Fig. 2. In this figure, data depicted represent the key focus of primary and, where relevant, second and third aims. As can be seen from this figure, teaching students communication skills accounted for most primary aims ( $n = 51$ , 36.2 %) and the second most frequent secondary aims ( $n = 18$ , 12.8 %). Primary and secondary aims were often linked, such that comparisons across types of AAC ( $n = 18$ , 12.8 %) were often determined in terms of improvements in communication productions: for example, low versus high technology AAC was compared by Tönsing (2016) to promote two-word

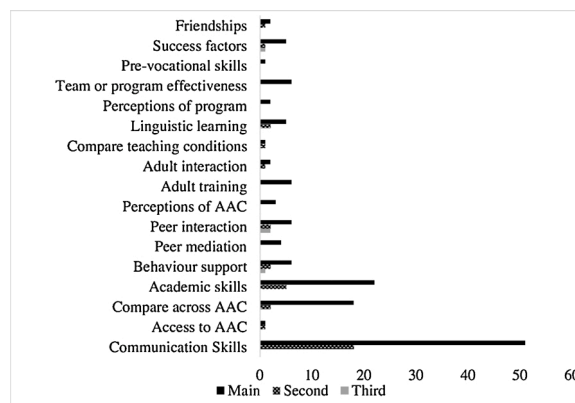


Fig. 2. Top three aims across studies.

combinations during shared book reading, and by [Gilroy et al. \(2018\)](#) to promote functional communication and social responding.

The aims of the studies were addressed using various research designs, as shown in [Table 1](#). SCED dominated (47.2 %), with various types employed, often in studies with the primary aims of teaching communication skills ( $n = 25$ ), comparing across types of AAC ( $n = 15$ ), and teaching academic skills ( $n = 11$ ). In terms of group experimental studies, Randomized Controlled Trials (RCTs,  $n = 8$ ) were employed largely to evaluate interventions targeting improved use of AAC, in particular PECS. Other quantitative designs included descriptive studies ( $n = 29$ ), many with the aim of improving communication ( $n = 17$ ), as with many descriptive case studies ( $n = 10$ ), some of which also addressed academic skills ( $n = 5$ ). Without control strategies, however, outcomes of these descriptive studies could not be attributed to interventions. Qualitative designs (7.8 %) were employed for varied aims, but most frequently to explore interactions or friendships with peers ( $n = 4$ ). In four studies, mixed methods, combining qualitative and quantitative approaches, were used to explore improvements in communication skills, alone ([Adams & Cook, 2017](#)) or in addition to academic skills ([Adams & Cook, 2014](#); [Myers, 2007](#)), and student perceptions of introduced Speech Generating Devices (SGD) (see Supplementary Table S1).

Across the studies, data were reported for 1086 students with disabilities, with participant numbers not reported in one study ([Howery, 2018](#)). Accounting for studies in which it was evident that data from the same students were reported (e.g., [Gordon et al., 2011](#); [Howlin et al., 2007](#)), in total 993 students with varied types of disabilities (e.g., intellectual disability, autism, cerebral palsy, dyspraxia, visual impairment) participated across the 141 studies (Supplementary Table S1). The number of students in individual studies ranged from 1 to 84, with a mean of 8.0 and a mode of 1, reflecting the predominance of SCED and case studies. With the exception of four studies in which data for students of pre-compulsory school age could not be disaggregated and two in which ages were not reported, students ranged in age from 4;9 (years; months) to 26 years. The oldest participants were from the study by [Hunt-Berg \(2005\)](#), for whom retrospective records during their school years were reviewed. Hence, participants across the studies attended primary (elementary) through to high (secondary) schools. A total of 71 classroom peers participated across 9 studies (range 1–17, mean = 7.9, mode = 10). Across 10 studies, 138 education staff, therapists and parents were participants (mean = 13.8). Varied types of AAC were used by students with disability. In 32 studies, signs were used or taught, in 73 low tech AAC (e.g., picture communication systems, Blissymbols on communication boards) and, in 93 studies, high tech AAC in the form of SGD. Further, in 50 % of studies ( $n = 70$ ), it was evident that students had access to AAC prior to their participation in the study; in 47 % ( $n = 67$ ) they reportedly did not; and in 3% ( $n = 4$ ) it was unclear.

### 3.2. Key findings

Despite the heterogeneity of study aims, designs, participant types and numbers, patterns relating to key findings that converged on the dominant aims of improved communication and academic skills were discernible from the extraction table (Supplementary Table S1).

Improved skills were demonstrated across various communication domains. These included pragmatic functions, most notably object requests, with increases demonstrated to be the direct outcome of AAC interventions using experimental designs - predominantly SCED ( $n = 25$ ), but also one RCT. Evidence was provided for the efficacy of early stages of the Picture Exchange Communication System (PECS), in which requests are the focus of the intervention (e.g. [Ali et al., 2011](#); [Carré et al., 2009](#); [Ivy et al., 2014](#)), with improvements for other functions, such as comments, found to be less consistent across participants in a study by [Travis and Geiger \(2010\)](#). Interventions incorporating various forms of AAC were associated with increases in verbs and nouns ([Ganz et al., 2014](#)), multi-symbol combinations ([Finke et al., 2017](#)), semantic relationships ([Nigam et al., 2006](#)), and use of grammatical morphemes ([Binger et al., 2011](#)). Attempts to improve socio-communication skills, such as initiations and responses to another's communication ([Alzrayer et al., 2019](#); [McMillan & Renzaglia, 2014](#)), turn-taking ([Drager et al., 2019](#)), and social interactions with peers ([Bau-minger-Zviely et al., 2020](#)) also met with success, with efficacy demonstrated through SCED or RCT. Similarly, improvements in communication skills were documented in descriptive studies (some of which included pre-post data), such as following requests produced by a researcher using tactile symbols ([Aasen & Naerland, 2014](#)), increased receptive and expressive vocabulary for varied

**Table 1**  
Study Designs and their Frequencies Across Included Studies.

Design	Description	Frequency
Quantitative - Group experimental	Randomized controlled trials in which students or groups of students (e.g., classrooms) are randomly allocated to treatment and control groups	10
Single Case Experimental Design (SCED)	Investigation of target behaviours in one or a small number of participants using repeated measures over time and controlling for confounds. Variations include ABAB, multiple baseline, multiple probe, alternating treatments	67
Quantitative - Group comparison	Participants in groups are compared on quantitative measures, but without control of potential confounds	3
Quantitative descriptive	Collection of quantitative measures of existing characteristics or behaviours at a single point in time or over time; no attempt to draw determine cause-effect	29
Quantitative case study	One or more single cases involving collection of data over time, but no attempt to control for confounds, such as AB designs	17
Qualitative	Approaches used to explore participant experiences and/or understand how they ascribe meaning to these: includes grounded theory, qualitative case studies or qualitative descriptions of focus group, interview, or field note data	11
Mixed	Implementation of quantitative and qualitative approaches to address specific questions determined a-priori	4

Note. Adapted from [Hong et al. \(2018\)](#).

communication functions through team support of a student's use of a SGD (Alant et al., 2013), and improvements in receptive and expressive communication, and social communication skills following the introduction of signs (Lal, 2010).

Of the 22 studies with the primary aim of improving academic skills, most targeted aspects of literacy, especially those in which SCED were employed. Studies demonstrated that interventions that included AAC were effective in teaching phoneme (Ahlgrim-Delzell et al., 2014; Truxler & O'Keefe, 2007) or letter identification or matching (Bailey et al., 2011; Light et al., 2008), word recognition (Ahlgrim-Delzell et al., 2014; Light et al., 2008), spelling skills (Raghavendra & Oaten, 2007; Sandberg, 2001; Schlosser & Blischak, 2004) and written story reading (Mucchetti, 2013; Tönsing, 2016). In a series of studies by Soto and colleagues, AAC interventions were found to support the development of narrative skills using various descriptive designs (e.g., Soto & Hartmann, 2006; Soto et al., 2006, 2009, 2007), but students remained reliant on teacher co-construction of stories in a study by Soto and Hartmann (2006). Other academic skills found to improve with AAC intervention were numeracy in a SCED study by Hudson et al. (2016), and mathematics (Adams & Cook, 2014) and independent on-task class behaviors (Collette et al., 2018) were documented to improve in descriptive design studies.

#### 4. Discussion

In addressing our aim of scoping research with students who were using or could benefit from AAC conducted within segregated school settings, we found that most of the 141 studies that met inclusion criteria have been narrowly focused on teaching communication skills, often basic requests. This finding contrasted with that of the review of inclusive setting studies (Iacono et al., 2021) that improving academic skills was a key aim in about a third of 28 studies, with another third addressing peer interactions and only a fifth targeting improved communication skills.

Evidence from this review and that reported by Iacono et al. (2021) is that school-based AAC research has occurred predominantly in segregated settings of special schools and self-contained units within mainstream schools. These findings suggest that although AAC has been argued to support students included in mainstream education (Calculator, 2009) and that the education of students with disability in settings considered least restrictive has increased (Morningstar et al., 2020), the direct evidence of AAC playing a supportive role in enhancing school inclusion has been limited. These findings align with concerns voiced by Morningstar et al. (2020) about evidence for inclusive education of students with severe disability remaining incomplete, despite progress in certain areas, and lacking the critical mass to support scaling up and sustainability of practices.

Reasons for differences in the predominant aims of studies across inclusive and segregated settings can be speculated at best given the array of potential factors. The finding that researchers sought to improve communication more often than academic or social skills of students in segregated settings most likely reflects the needs of these students to be able to access a means of communication by virtue of the severity of their disabilities. Students with complex communication needs who require access to AAC, in particular, are most likely to attend segregated school settings (Kleinert, 2020) as a result of placement biases arising from low expectations influenced by a student's disability label or educators' lack of skill and confidence in adapting to their needs (Agran et al., 2020; Iacono et al., 2019; Wehmeyer et al., 2020).

What seems clear from this review is that, in almost half the studies, despite their complex communication needs, students did not have access to AAC until their participation in the research. In some studies, little if any use of or access to symbolic communication was a selection criterion in order to address research aims and reduce potential design confounds (e.g., Brady et al., 2015; Ivy et al., 2014). In other studies, the functionality or spontaneous use of AAC introduced prior to the study was limited (e.g., Desai et al., 2014; Simpson et al., 2000; Strasberger & Ferreri, 2014; Tönsing et al., 2014) or difficult to discern from participant description (Lal, 2010; Valentino & Shillingsburg, 2011). The predominant need of student participants to access a functional means of communication (Kleinert, 2020) could, therefore, result in the appropriate prioritization of investigations into improved communication skills over academic learning or building of social networks.

In order to support evidence-based selection of interventions to promote communication in children with complex communication needs, efforts to test the efficacy of various types of AAC have dominated research in the field, which may explain why relatively few studies have aimed to address the role of AAC in inclusive education. As a case in point, studies into PECS included in this review demonstrated its usefulness in teaching requests, largely with children with Autism Spectrum Disorder (e.g. Charlop-Christy et al., 2002; Collette et al., 2018; McLay et al., 2015; Tincani et al., 2006), as well as those with intellectual disability (Carré et al., 2009), visual impairment (Ali et al., 2011; Ivy et al., 2014), and developmental language disorders (Cummings et al., 2012), but have as yet to provide the strength of evidence needed through experimental designs with clear outcomes for teaching different communication functions (Logan et al., 2017). Recruitment of children who best meet criteria for these efficacy studies (i.e., lack of previous exposure to PECS or other form of aided AAC) will have greater chance of success in special schools, in particular, if gold standard evidence is sought through employment of RCTs, which requires relatively homogeneous groups of children (Gordon et al., 2011; Howlin et al., 2007), who are unlikely to be found in mainstream schools.

Also evident from the predominant aim of demonstrating the efficacy of various types of AAC, including comparisons across them or teaching approaches, has been a lack of opportunity to evaluate how use of AAC has been integrated into the students' classroom settings. No doubt, in an effort to reduce distractions that introduce potential confounds, particularly important in experimental studies, students were often seen in rooms separate to their classrooms (Brady, 2000; Dada & Alant, 2009) or in a part of the classroom separate to others in didactic individual teaching situations (e.g., Mucchetti, 2013; Nigam et al., 2006; Schlosser et al., 2007). Although there were some attempts to test for generalisation of skills, these have tended to be limited to interactions with adults (e.g., Schlosser et al., 2007; Sevcik et al., 2018), rather than with peers. As a result of a lack of data collection under typical classroom conditions, the research focus has remained on efficacy (ideal conditions). In contrast, there has been little opportunity to evaluate interventions for



effectiveness (real-life conditions), or to further understand the functionality of AAC or its role in academic learning and peer interactions beyond that provided through descriptive observations (Andzik et al., 2016; Carter, 2003; Raghavendra et al., 2012), qualitative analysis (Clarke & Kirton, 2003; Clarke & Wilkinson, 2008), or quasi-experimental studies (Lilienfeld & Alant, 2005; Tan & Alant, 2018). These limitations may well be understood in terms of time and resources available to complete studies, which are particularly challenging for doctoral or other higher degree by research candidates, and the need to build up the evidence base through efficacy studies.

#### 4.1. Implications

Overall, the results of this scoping review demonstrate that, despite the extent of research that has been conducted in schools, there remains little evidence of the role of AAC in supporting school participation in terms of academic learning or social interactions. The focus in teaching the use of AAC no doubt reflects the continued lack of functional AAC for children with complex communication needs (as noted by Kleinert, 2020), at least across countries from which the research has emanated. Relatedly, this focus may be the consequence of a belief that functional use of AAC is essential for accessing the academic curriculum or the school/classroom social milieu (Calculator, 2009). Students without functional communication are likely to continue to be excluded from these core activities of school life, even in segregated settings, because of efforts to spend the school day learning to use their AAC systems rather than engaging in academic learning or socially engaging with peers. Studies from inclusive settings reviewed by Iacono et al. (2021) call into question the belief that students will not benefit from these activities without foundation communication skills. From their review, these researchers found evidence that students with complex communication needs with only limited proficiency in using AAC, some without any symbolic communication, were nonetheless forming friendships and socially interacting with their mainstream classroom peers, who adapted to their communication differences. Although there were exceptions, this research was largely qualitative. Therefore, evidence for the role of AAC in supporting social interactions and friendships with mainstream peers is emergent, at best. Incorporating interventions into real world settings, whether segregated or inclusive, could deepen understanding of and extend the evidence into the role of AAC in supporting student academic learning and social interactions.

Furthermore, in searching for the most efficacious AAC for students with complex communication needs, there is a danger of promulgating a pre-requisite model, whereby students may be engaged in learning to use AAC functionally and proficiently (however defined), prior to being afforded opportunities to access the full benefits of being in a school environment. An insistence on functional communication, with or without AAC, could also contribute to ableist concepts that have influenced the exclusion of students with complex communication needs from mainstream schools or classrooms in the false belief that they cannot engage in or benefit from an academic curriculum (Agran et al., 2020; Iacono et al., 2019). Requiring proficiency in AAC could also deny peers the benefits that accrue from interacting with and often supporting peers with disability (Agran et al., 2020; Finke et al., 2009), which has been demonstrated both in segregated studies reviewed here (Lilienfeld & Alant, 2005; Tan & Alant, 2018; Trottier et al., 2011) and in inclusive settings reviewed by Iacono et al. (2021). However, research into social networks with peers with disabilities, but not others with complex communication needs, suggests that they are limited (Raghavendra et al., 2012) and friendships tend to be superficial (Østvik et al., 2017). These findings contrast with those involving peers without disability in mainstream settings (Iacono et al., 2021), perhaps indicative of the need for more developed communication by peers to learn or use their own strategies to support interactions with students with complex communication needs, and their experiences in friendships. Research is needed to explore these differences to strengthen the evidence base for inclusive education practices.

Finally, the results of this review highlight a continued need for advocacy and policy change to ensure students with complex communication needs have access to inclusive education settings. Our review highlighted the reality that most research occurs in segregated settings for students with complex communication needs, because they are not given access to inclusive settings (Kleinert, 2020). Using a consultation process, Morningstar et al. (2016) noted three key areas, which if addressed, could bridge gaps in the research needed to inform policy and practice changes: (a) research to build capacity at the system level (e.g., research exploring school-wide reform, least restrictive education placement decisions, and teacher preparation); (b) research conducted at building and classroom levels (e.g., exploring the implementation of systematic instruction, adult roles, access to curriculum); and (c) explorations of student learning and development (e.g., social relationships, communicative competence, instructional strategies). We echo their recommendations and the need for continued advocacy, policy, and research to support the inclusion of students with severe disabilities, especially those with complex communication needs.

#### 4.2. Limitations

A key limitation of this study was the failure to consult with potential stakeholder groups, a step suggested as optional but useful by Arksey and O'Malley (2005). Involvement of educators and policy makers, as well as AAC researchers and families of students attending segregated and inclusive school settings could have enhanced the findings, such as through narrowing the focus to those felt most relevant and useful in informing future research and translation activities. This step, however, can be particularly challenging in reviews of international studies, both in terms of the resources required to ensure true stakeholder representation and relevance across countries and educational jurisdictions. This step may be better addressed in a future more tightly focused systematic review, such as of the effectiveness of AAC in supporting academic skills and social inclusion of students across settings, such that studies with the aims of improving communication skills without attempts to generalize them into classroom contexts or student peer interactions are excluded. Consultation across key points of the review offers the potential to ensure a rigorous process and translatable findings.



### 4.3. Conclusion

AAC research in school settings has demonstrated its role in supporting both academic learning and development of social connections, but the evidence base is far from strong. There remains a need for real world effectiveness research into how AAC can best support learning. This need can be met, not only through studies that include examination of the generalization of skills learned when segregated from peers into the classroom or school contexts, but also studies in which skills are taught directly within these contexts. In these ways, requirements for students with complex communication needs to demonstrate their competency in communication using AAC, thereby placing another pre-requisite hurdle to their access to rich academic and social learning opportunities, can be challenged by empirical evidence. Research could then contribute to further challenging false beliefs about the potential of students with severe disability, thereby increasing inclusive educational opportunities for students with complex communication needs.

### Author contributions

Teresa Iacono conceptualized the study, contributed to the design, drafted the search protocol and submitted it to PROSPERO, completed the initial search, all hand searches and forward citation searches, conducted all screening, lead the extraction of data and completed data coding, wrote the initial draft of the full manuscript and was responsible for the final submission.

Sarah Douglas completed second title and abstract screening of approximately half of the studies, assisted with resolution of disagreements, completed initial extraction of approximately half of included studies, and reviewed and contributed to manuscript drafts.

Ana Garcia-Melgar conducted database searches, screened most titles and abstracts, managed databases, conducted full-text screening, assisted with data abstraction and conduct of reliability checks for coding, assisted with manuscript preparation and contributed to and reviewed manuscript drafts.

Juliet Goldbart contributed to the conceptualization of the study and the search protocol, completed second title and abstract screening of approximately half of the studies, including those published in languages other than English, and in resolution of disagreements, and reviewed and contributed to manuscript drafts.

### Data availability

No data was used for the research described in the article.

Data will be made available on request.

The data that has been used is confidential.

### Declaration of Competing Interest

The authors report no declarations of interest.

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