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Facilitators and barriers to the implementation of the picture exchange communication system (PECS): a systematic review

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Background and aims: Although there are several published systematic reviews and meta-analyses of the effectiveness of the Picture Exchange Communication System (PECS) protocol, no previous review has focused on factors affecting its implementation. The present review attempted to identify potential barriers and facilitators in implementing PECS, as well as examining authors' and stakeholders' views and experiences in terms of implementation.

Methods and procedures: A total of 49 studies were identified through a systematic review search process and were included in the data extraction phase. A Content Analysis of previous researchers' comments was also carried out.

Outcome and results: During the data extraction and synthesis phase, it became evident that important features of PECS interventions are not systematically reported in published literature. Thus, our primary research question remained partially unanswered. A Content Analysis of previous researchers' comments revealed four potential implementation factors, including Contextual & Environmental Factors, PECS Training/Consultation, Supervision and Implementation Fidelity and Adherence to the Protocol.

Conclusions and implications: The identification of potential barriers or facilitators affecting the implementation of PECS is not currently possible. The present review's identified implementation factors were extracted from qualitative analysis of previous researchers' anecdotal remarks or from the social validity measures. Implications in terms of previous PECS literature findings are discussed.

Systematic review registration: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42018099767.

KEYWORDS

PECS, facilitators, barriers, contextual factors, implementation

1 Introduction

The Picture Exchange Communication System (PECS; Bondy and Frost, 1994) is an extensively researched communication program, widely used in intervention programs for individuals with autism spectrum disorders (ASD) and/or intellectual/developmental disabilities (IDD) when speech development is delayed or does not develop (Preston and

Carter, 2009; Ganz et al., 2012). PECS is a picture-based system consisting of pictorial images or symbols that may serve as an alternative or augmentative communication system or tool for non-verbal individuals (Bondy and Frost, 1994).

The PECS user is taught how to approach another person (communicative partner) to exchange a picture card for a desired item, and to receive the item depicted on the card. PECS teaching and error-correction procedures are outlined in a detailed protocol (Bondy and Frost, 2002). The protocol details six distinct phases ranging from teaching the user to request a single item through to being able to construct sentences, include adjectives as part of requests, answer basic questions and comment about their environment. The protocol specifies the materials to use, instructional, prompting levels, and mastery criteria for each phase (Bondy and Frost, 2001, 2002).

The PECS protocol combines procedures that promote motivation and initiation, including choice and preference (Dyer, 1989). A preference assessment (assessing potential motivating items for the individual) is a critical step prior to intervention (Frost and Bondy, 2002). The protocol also encompasses teaching strategies derived from behaviour analysis including differential reinforcement, incidental teaching, environmental arrangement and time delay as well as generalisation strategies (Schwartz et al., 1998; Stoner et al., 2006). The protocol recommends that PECS is conducted throughout the day, in a range of environments and with different people. Ideally, a PECS instructor contrives frequent learning opportunities during each teaching period by arranging contingent access to preferred items (at least 30–40 opportunities per day or per session; Frost and Bondy, 2002).

The PECS protocol has been found to be simple to teach and implement (Stoner et al., 2006), and requires minimal prerequisite behaviours (e.g., eye contact, joint attention, or initiation; Bondy and Frost, 1998, 2002). PECS materials (e.g., book, pictures, etc.) are low cost or can be alternatively created by staff (Schwartz et al., 1998). No electronic equipment needs to be purchased or maintained, making PECS an attractive system for use in contexts including those where access to computer technology may be limited.

A substantial number of studies have evaluated the effectiveness of PECS, demonstrating that the protocol can be acquired rapidly (Bock et al., 2005; Beck et al., 2008; Carre et al., 2009; Cummings et al., 2012; Gilroy et al., 2017) and result in increases in social-communicative behaviours, as well as decreases in disruptive problem behaviours (Charlop-Christy et al., 2002; Ganz and Simpson, 2004; Anderson et al., 2007; Hart and Banda, 2009). PECS has also been shown to be effective in the development of spontaneous speech (Magiati and Howlin, 2003) with gains usually occurring over a relatively short time period (between 6 to 14 months; Schwartz et al., 1998; Webb, 2000). There is also some evidence to suggest that PECS is effective in teaching functional communication skills to adults (Chambers and Rehfeldt, 2003; Rehfeldt and Root, 2005; Stoner et al., 2006; Ziomek and Rehfeldt, 2008; Rosales et al., 2009; Conklin and Mayer, 2010).

In a review of the literature, Lancioni et al. (2007) noted that only three from 173 PECS users failed to develop functional communication skills. Similarly, Sulzer-Azaroff et al. (2009) synthesised data from 34 peer-reviewed studies to conclude that PECS is effective in increasing functional communication for individuals with impaired or no speech. Preston and Carter (2009) suggested that PECS is effective in providing a means of communication for individuals with little or no speech. Schlosser and Wendt (2008) further concluded that PECS was highly effective for teaching requesting to children with ASD.

Although these reviews suggest that PECS is effective at establishing a functional communication repertoire in individuals with ASD/IDD, they included studies conducted in ideal training environments, such as highly structured settings such as University clinics with ample staff support, supervision in terms of implementation fidelity etc. Reviews of PECS studies conducted in real world settings though have highlighted problems with its implementation and generalisation. Flippin et al. (2010) for example, concluded that PECS is a promising but not yet established evidence-based intervention for facilitating communication in children with ASD, as they found small to moderate gains in communication and small to negative gains in speech. They also raised concerns about its maintenance and generalisation effects to real world settings and conditions that closely resemble the everyday environments in which the intervention was intended to be implemented (e.g., special education settings).

To more fully evaluate effectiveness, both the intervention and its implementation need to be considered, to fully understand outcomes and impacts (Kelly and Perkins, 2012). A possible factor affecting PECS implementation for example, might be staff training and supervision. Although implementers attend PECS training and receive typical levels of support (provision of PECS books, materials and reinforcers, continuous emphasis on alternative communication systems etc.), some earlier studies suggested that there is minimal implementation of the intervention (Ganz et al., 2013a). Magiati and Howlin (2003) for example, suggested that PECS implemented by untrained staff may be unsystematic and inconsistent. Similarly, Tincani and Devis (2011, p. 211) noted that PECS requires proper and thorough training if it is to be implemented correctly, arguing that "it is a complex system requiring myriad teaching procedures, including most-to-least prompting, least-to-most prompting, shaping, chaining, and error correction." On a similar note, Howlin et al. (2007) found that teachers had difficulty maintaining communicative gains (rates of initiations and use of PECS symbols) achieved with PECS when classroom consultation visits ended, perhaps in part because expert consultation did not fully establish complex teaching repertoires necessary to implement PECS without external support. These concerns are consistent with the findings of a recent study by May et al. (2024) who reported that the use of PECS by educators with minimal training was often sub-optimal, and that formal training in PECS was associated better implementation practices.

Existing PECS reviews and meta-analyses have also raised a number of concerns regarding the outlined experimental designs, reliability measures, procedural integrity, and behavioural change outcomes (Sulzer-Azaroff et al., 2009; Flippin et al., 2010; Tincani and Devis, 2011; Ganz et al., 2012). Several directions for future PECS research have been identified, particularly the need for further research into social validity and procedural integrity of the intervention as used in practice.

A key factor to the implementation of any intervention, is the application of the intervention's core components, which are its essential aspects without which the intervention will fail to be sustainable or effective (Fixsen et al., 2005). Thus, procedural integrity is an important factor when implementing PECS. Adherence to the training protocol is hypothesised as being essential in establishing positive behavioural and communication

TABLE 1 Exclusion and inclusion criteria.

Study item	Inclusion criteria	Exclusion criteria
Type of research	Original/primary research.	Secondary research, e.g., discussions, review articles, conference presentations, and blogs.
Publication requirements	Published in a peer-reviewed journal.	Published in a book, case reports, non-peer-reviewed work, and unpublished work, e.g., dissertations.
Date	Any year.	N/A.
Language	English and Greek language.	Any language other than English/Greek.
Participants	Individuals with an IDD and/or ASD diagnosis, regardless of age and setting. At least 70% of reported participants with IDD and/or ASD diagnosis or subgroup results are separate	Individuals with any other disability other than IDD or ASD. Less than 70% of reported participants with primary diagnosis of ID and/or ASD for whom results are not reported separately
Setting	Any setting (school, college, university, clinic, day centre etc.)	N/A.
Informants	Parents, carers, therapists, support staff and teachers.	N/A.
Methodology/ study design	Quantitative, qualitative, and mixed methods studies (controlled trials, RCTs, single group pre-post design, single case experimental design, qualitative studies reporting staff experiences or opinions)	Studies not reporting any data, insufficient methodological information, case studies not involving a single-case experimental design, A-B case studies or studies that do not include a target question specific to the PECS protocol
Findings/ outcome variables	Studies reporting findings specifically on facilitators and barriers to the PECS implementation or staff experiences.	Papers that do not include any findings specific to the PECS protocol or staff experiences.

gains, as well as promoting the user's spontaneous and independent communication (Magiati and Howlin, 2003). Inconsistent implementation of the protocol may result in prompt dependency, in which PECS is used only when assisted by the implementer (Bondy, 2012). It is thus critical for implementers and researchers to demonstrate implementation fidelity, to validate the PECS protocol as well as to attribute intervention outcomes to its full implementation. It might well be the case that a higher implementation of the protocol leads to greater participant outcomes. Yet the extent to which fidelity measures are reported in published PECS studies varies, due to researchers using different procedures to calculate implementation fidelity or not reporting quantitative [fidelity] data (Preston and Carter, 2009; Flippin et al., 2010; Tincani and Devis, 2011). Thus, our understanding of the impact of implementation fidelity on PECS remains weak. There also seems to be a variability in the outcomes reported in different systematic reviews and meta-analyses.

Overall, previous systematic review concentrated on the effectiveness of PECS in teaching functional communication skills, increasing social-communicative behaviours, decreasing problem behaviours, and developing spontaneous speech. Some studies though have suggested that there are different factors that may affect the protocol's implementation. There has been no systematic review to date, that examines the potential facilitators or barriers relating to PECS implementation. The present review thus revisits the published studies on PECS, to identify how the intervention has been implemented. The literature was screened to identify potential barriers or facilitators, including staff training, implementation support and supervision, protocol adherence, setting characteristics, PECS specific problem-solving procedures, and staff training (Review Question 1; RQ1). The views and experiences of staff and/or other stakeholders, as well as researchers' comments in published papers were also examined in terms of identifying potential factors affecting implementation (RQ2).

2 Article types

2.1 Research protocol

The systematic review protocol was registered with PROSPERO (available from corresponding author on request). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher et al., 2009) guidelines for reporting systematic reviews were used in reporting the systematic review.

2.2 Inclusion and exclusion criteria

Published literature was included in the systematic review based on the criteria as shown in Table 1. There was no criterion regarding the studies' setting(s) or participants' age. The review included only participants with a primary diagnosis of ASD or IDD as previous studies have shown that PECS is an effective means of improving outcomes specifically for this population. Studies with mixed samples of participants with other diagnoses were included, as long as data for those with ASD/IDD were reported separately. Studies that involved participants with visual or hearing impairments were excluded, as this would involve an adaptation of the PECS protocol to meet their needs, and this on its own could be a barrier to the protocol's implementation. Studies involving interventions that used variations or adaptations of the PECS protocol or examined different deviations in terms of its training procedures were excluded.

2.3 Search strategy

Six electronic databases (ERIC, PubMed, PSYCHINFO, ASSIA, SSCI and SCOPUS) were searched in September 2018. Initial search terms were piloted and refined after sequential testing to ensure that

TABLE 2 Search terms employed across databases.

Search terms	Database	Results
Search Line 1: Autis*, "ASD," "Autism Spectrum Disorder*," "Intellectual Disabilit*," ID, "Mental Retardation," "Developmental Disabilit*," "Down Syndrome," Pervasive, PDD, Asperger*, "Learning Disabilit*," "Learning Difficult*," "Learning Impairment*," "Intellectual Deficien*," "Developmental Impairment*," Handicap*	ERIC 214 PSYCHINFO 1716 PUBMED 110 ASSIA 87 SSCI 600 SCOPUS 135	
Search Line 2: "Picture Exchange Communication System*," PECS, "Communication System*," "Augmentative and Alternative Communication System*," "Selection-based communication system*"		

Search line 1 – Terms from List 1 separated with OR.
Search line 2 – Terms from List 2 separated with OR.
Both search lines combined with AND. All terms scanned against titles, key words and abstracts.

the search captured all relevant keywords. The final search string can be seen in Table 2. After the initial search, the included studies were forward and backward searched to identify further articles and to make sure all studies included in earlier reviews were included. Backward searching involved the assessment and screening of all records cited within the reference lists of all review's cited articles, whereas forward searching involved the identification of articles that have cited the review's cited articles. A brief "grey literature" search was also conducted, revealing two thesis manuscripts, one of them being a systematic review and the other being published and already identified. The authors of any articles that were not available through the university library database, were contacted directly for a copy of the manuscript. The search was repeated on three further consecutive times (April 2019, December 2022 and November 2023) to check for any newly published studies, with three ($n = 3$) more studies being identified for inclusion.

2.4 Study selection

The study selection process is summarised in Figure 1. Overall, a total of 2,862 records were identified through initial database searches and a further six through backward and forward reference searches. Six hundred and forty nine internal and external duplicates were removed. The first author carried out the initial screening of titles and abstracts against inclusion criteria of all returned results and a further 2,108 records were excluded after an initial screening of titles, abstracts and keywords. The fifth author (MA) independently verified inclusion/exclusion for 20% ($n = 364$) of randomly selected records.

A total of 116 studies (full texts) were assessed for inclusion eligibility, of which 68 (58.6%) were excluded (reasons for exclusion for each study are summarised in Figure 1). Similarly, the fifth author (MA) verified inclusion/exclusion for 22.4% ($n = 26$) of the studies. A total of 49 studies were included in the data extraction phase (Supplementary material).

2.5 Data extraction and synthesis

Data extraction was based on a customized tool and included study, setting and participant characteristics as well as contextual factors (frequency and duration of PECS sessions, number of reinforcers used etc.; Supplementary Tables S1, S2). The first author (AP) completed the data extraction for all included articles, whereas the fifth author (MA) independently completed extraction for 20.8% ($n = 10$) of randomly selected articles, with no disagreements. Included studies were summarised using a narrative synthesis. The fifth author (MA) had experience of systematic reviewing and was trained by AP in the inclusion/exclusion criteria for the current study.

2.6 Data extraction and synthesis—qualitative analysis

All reviewed studies were scanned for authors', parents' or implementers' comments in order to identify potential factors that could act as barriers or facilitators (Supplementary Table S3; qualitative comments). A Qualitative Content Analysis (QCA; Erlingsson and Brysiewicz, 2017) was used to analyse the identified data. The QCA can be described as "the systematic reduction of content, analysed with special attention to the context in which it was created, to identify themes and extract meaningful interpretations" (Roller and Lavrakas, 2015, p. 232). The procedure involves the author: (a) familiarising oneself with the data, (b) dividing up text into smaller parts (meaning units), (c) condensing the identified meaning units, (d) labelling condensed meaning units by formulating codes, (e) grouping these codes into categories, and (f) grouping these categories into themes (Hsieh and Shannon, 2005). The first author conducted the content analysis and categorised the content in themes. The first author conducted the content analysis and categorised the content into themes. Reliability was confirmed by a second rater (LD; second author) and also further refined and discussed within the research team.

3 Results

3.1 Research characteristics

3.1.1 General characteristics

All included studies were published between 2001 and 2019. Approximately half of the studies were published before 2010, with 23 (46.9%) being published between 2001 and 2010 and 26 (53.1%) being published between 2010 (including) and 2022. All studies included data on PECS implementation. Table 3 present a summary of included studies.

3.1.2 Participant characteristics

A total of 577 participants participated in the studies, including 256 (44.4%) males and 48 (8.3%) females. Eleven studies (22.4%) did

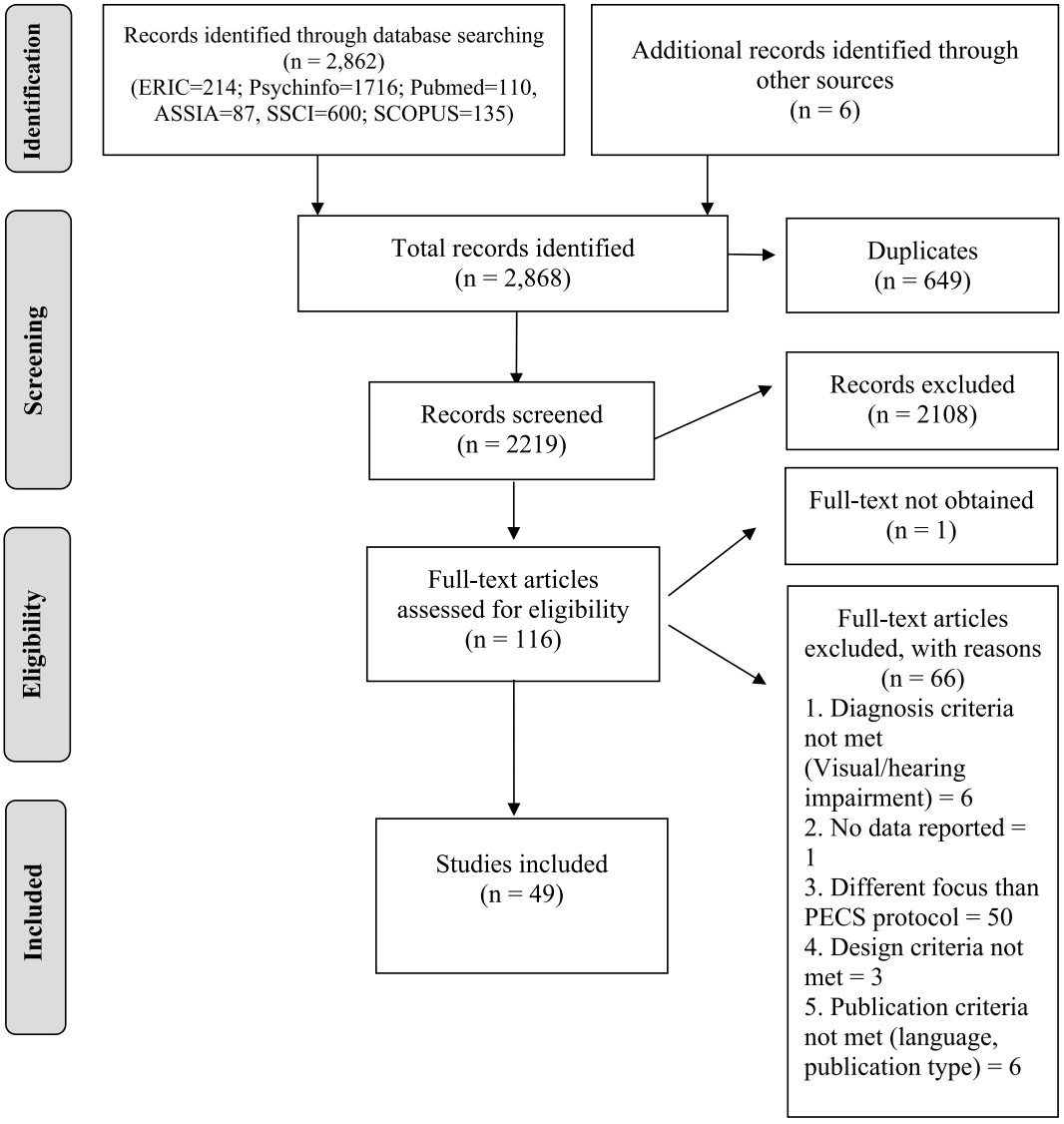

FIGURE 1
Flow diagram illustrating study selection process (adapted from PRISMA Diagram —Moher et al., 2009).

not report participants' gender. Age was reported in the majority of the studies ($n = 46$; 93.9%) and ranged from 16 months to 52 years of age, with 18 participants (3.1%) being above 18. In terms of participants' race and ethnicity, 36 studies (73.5%) did not report this.

3.1.3 Study design

Our systematic review focused on the identification of potential barriers and facilitators to implementation of PECS in published literature on PECS. We thus made no distinction in terms of the design or purpose of an individual research study but rather drew on all published PECS evaluation studies as the source of "data" to answer this review questions.

Overall, single-case designs were employed for the majority of the studies ($n = 36$; 73.5% versus $n = 13$; 26.5% for group studies), with multiple baseline designs (MBD) across participants or settings ($n = 18$; 37.1%) being the most common. Overall, a total of seven (14.3%) studies employed an alternating treatments design (ATD), whereas six (12.2%) used a changing criterion design (CCD), three (6.1%) used a mixed single case design (ATD with MBD) and two (4.1%) employed a reversal design (RED). In terms of group design studies, a randomised control trial design was utilized in nine (18.4%) studies, whereas two studies (4.1%) compared the intervention effects between groups and only two (4.1%) included within-group comparisons.

3.1.4 Dependent variables

Twenty two studies (44.9%) included PECS specific dependent variables, such as number of phase specific exchanges, average number of trials to reach phase criterion, percentage of accuracy exchanges etc., whereas 27 (55.1%) studies included or concentrated on concomitant non-PECS specific measures, including speech production, mean length of utterance, frequency of spoken words etc. Finally, seven studies (14.3%) targeted staff, teachers or parents training on implementing the protocol (number of correct responses

TABLE 3 Summary of extracted factors of studies in RQ1 ($n = 49$).

Potential barrier/facilitator	Study (*N*)	Percentage of studies
Delivery format		
Reported	*26*	*53.1*
Individual format	21	42.9
Group format	5	10.2
Not reported	*23*	46.9
Intervention fidelity		
Reported (May not include data)	25	51
Not Reported	24	48.9
Intervention duration or total number of sessions		
Reported (or derived from graphs)	42	85.7
Not reported	7	14.3
Individual session duration		
Reported	24	49
Not reported	25	51
Number of reinforcers used in intervention		
Reported	25	51
Not reported	24	48.9
Preference Assessment carried out		
Reported (or mentioned)	32	65.3
Not reported	17	34.7
Explicit Mention of specific PECS phase(s) employed		
Reported (may not include rationale for choice)	45	91.8
Not reported	4	8.2
PECS staff training		
Reported	18	36.7
Not reported	31	66.3
PECS supervision and support		
Reported	14	28.6
Not reported	35	71.4
PECS phase data presented/reported		
Presented/reported	28	57.1
Not presented/reported	21	*42.9*
Generalisation		
Presented/reported	20	40.8
Not presented/reported	29	59.2

according to protocol, percentage of correct steps on task analyses within PECS phases etc.), whereas the rest ($n = 41$; 83.7%) targeted PECS recipients.

3.1.5 Intervention setting

Ten (20.4%) studies were carried out in a special education setting, whereas only six (12.2%) were carried out in a general education school. Eighteen (36.7%) studies were carried out in a clinical setting (University or private clinic), whereas nine (18.4%) were carried out in the participants' home. The remaining studies were carried out in an adult day program ($n = 3$; 6.1%) and in a summer school ($n = 1$; 2%).

3.2 Review question 1—data synthesis

In terms of RQ1 and the identification of potential (and contextual) barriers or facilitators to PECS implementation, a customized tool including twelve different factors was used to extract data from the reviewed studies (see Supplementary Tables S1, S2 for a summary).

3.2.1 Format of PECS delivery

Out of 49 included studies, 26 (53.1%) explicitly reported the format (implementer to recipient ratio) for the delivery of PECS, out

of which 21 (80.1% of reported studies) employed a 1:1 (implementer to receiver) format, whereas seven (26.9%) studies employed more than one member of staff per recipient throughout the intervention. In one study (Santos et al., 2021) a family member was also present in the sessions. In five studies (19.2%), intervention was delivered to a group of recipients. The duration of PECS intervention was reported in most studies ($n = 42$; 85.7%), whereas less than half of the studies ($n = 23$; 46.9%) reported the individual session duration. It must be noted though that a number of studies did not explicitly report this, and data were extracted from the graphs. Intervention and session duration were reported either in terms of time, or the total number of sessions or trials within a session, thus range was not possible to be calculated.

3.2.2 Intervention fidelity

In terms of intervention fidelity, 25 studies (51%) reported employing a measure for this. Although some studies did mention intervention fidelity, the data or assessment method/procedure were not consistently reported across them. Around half of the studies ($n = 28$; 57.1%) presented or reported data on the individual PECS phases.

3.2.3 Preference assessment and reinforcer variability

The use of individualised reinforcements identified through preference assessments is pivotal for the implementation of PECS. Despite this, not all studies mentioned or described a preference assessment being implemented prior to the intervention ($n = 33$; 67.3%). Twenty five (51%) studies explicitly reported how many different reinforcers were identified and employed for every participant. Studies' preference assessment procedures and the number of reinforcers identified and utilized for PECS, were not consistently described or reported in studies.

3.2.4 PECS phases targeted

Most studies ($n = 45$; 91.8%) explicitly stated the PECS phases that were employed in the study. However, the rationale behind this choice, thus linking the intervention with the study's specific aim(s) with the dependent variables, was not consistently provided (see also Supplementary material).

Out of the 45 studies that did report the targeted PECS phases, eight studies (17.7%) targeted PECS phases 1 to 4, two studies (4.4%) targeted Phases 1 to 3A, four studies (8.8%) included Phase 3B, ten studies (22.2%) targeted Phases 1 to 3, five studies (11.1%) included Phase 3A only, one study (2.2%) included Phases 2, 3A and 4, whereas four studies (8.8%) targeted Phase 6. Furthermore, one study (2.2%) included Phases 1 & 3, one study (2.2%) included Phases 3B and 4, four (8.8%) targeted Phase 4, one (2.2%) included Phases 1 and 2, one study (2.2%) targeted Phases 2 and 4, whereas only two (4.4%) targeted all PECS Phases (1 to 6) (see also Supplementary material). One study (2.2%) reported on the average of the PECS phases they targeted (average phase = 4.6). Four studies (8.8%) did not report what PECS Phases they targeted.

3.2.5 Staff training in PECS, supervision and support

Only 17 studies (34.7%) reported the specific PECS training the study's implementers received, or the type/duration of it. Out of these studies, only ten studies indicated the employment of the official Pyramid PECS training. Furthermore, only 14 studies (28.6%) mentioned that PECS consultation was offered to implementers for troubleshooting of any problems.

3.2.6 Generalisation of intervention

Less than half of the studies ($n = 20$; 40.8%) explicitly described a generalisation phase or generalisations strategies being incorporated in the intervention. From these, 11 (55%) included a generalisation-across-settings phase, three (15%) included a generalisation-across-PECS implementers phase and five (25%) included both. Only one study (5%) included a generalisation across-settings, participants and stimuli component.

3.3 Review question 1—qualitative synthesis

Qualitative authors' comments were extracted from 35 reviewed studies (Supplementary Table S3), with 14 studies not including any important content. These were analysed using Content Analysis to identify recurring themes regarding the implementation of PECS. After applying initial coding, 123 meaning units were identified, that were later sorted into 21 first order codes, by collating similar meaning units together. These codes include various elements that can serves as both potential barriers and facilitators in the different reviewed studies. It is thus best to view these as implementation factors that can either promote or hinder the implementation of PECS. The process of collating data together was carried over in creating eight categories that were then grouped into four higher order themes (Figure 2). The final four higher order themes included: Contextual and Environmental Factors, PECS Training, Supervision and Implementation Fidelity and Adherence to the PECS protocol (Figure 2).

3.3.1 Contextual and environmental factors

Different *organisational factors* that may act as barriers to implementation of PECS emerged during the analysis. Some authors explain how constraints in resources affect implementation: "on several occasions, the PECS picture cards had to be re-created due to excessive wear and tear" (Boesch et al., 2013, p. 489) or "access to an electronic software program that is capable of producing pictorial icons is necessary, otherwise the production of numerous icons is cumbersome" (Stoner et al., 2006, p. 164). Overall, factors like availability of PECS books, lack of symbols, or access to software to create these, seem to impact PECS implementation.

Other authors mentioned *time constraints* in terms of implementing PECS protocol as a potential barrier: "the [intervention] was time-limited because the clinic's semester was ending and there would be a 2-month break" (Ganz et al., 2013b, p. 85) or "lack of time in everyday routines" (Jurgens et al., 2018, p. 340). It seems that in terms of clinic settings, holiday breaks and limited weekly intervention time are significant barriers to implementation.

Another recurring emerging organisational factor affecting implementation involves *staff constraints*. Some authors comment that "PECS requires a large amount of adult facilitation, particularly in the first two phases of training" (Ganz et al., 2008, p. 168) and that "for the first and second phase of PECS, two teachers were assigned; one as

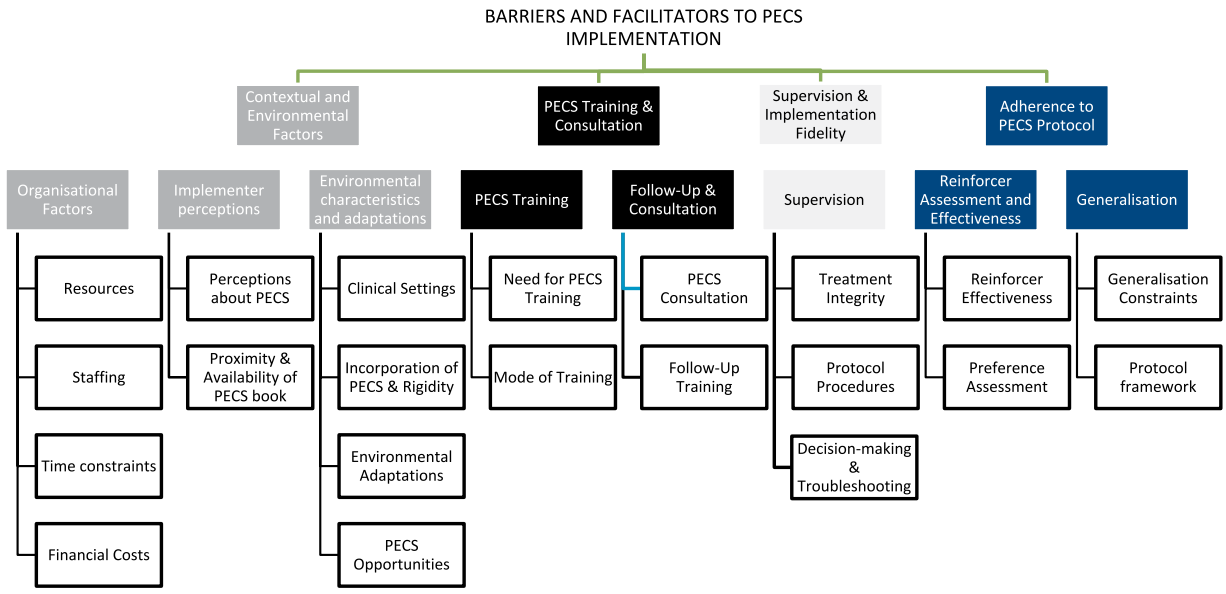

FIGURE 2
Barriers and facilitators to PECS implementation.

prompter and the other as communicator" (Odluyurt et al., 2016, p. 154). This though, can be difficult to achieve because of "frequent staff changes and substitutions and a classroom schedule which varied considerably from day to day" (Tincani, 2004, p. 162) or "due to staff and budget cuts" (Barnes et al., 2011, p. 1579).

The *financial costs* of running the PECS protocol have also been identified as a recurring factor affecting implementation. There seems to be different opinions regarding the financial costs of PECS. For some, the protocol seems to be cost-effective in terms of materials needed in comparison to other communication systems, resulting from the view that PECS "is a relatively cost-effective and easily portable approach that can be implemented in a variety of settings making it appealing to both families and professionals" (Carson et al., 2012, p. 184) and due to its "low cost, ease of maintenance, and portability" (Boesch et al., 2013, p. 489). For others, it seems that the financial implications of training staff ("brief instructions, manuals, and training videos may be preferable because of their low cost and time requirement"; Barnes et al., 2011, p. 1578) and running the protocol in terms of personnel and supervisors ("significant restrictions on financial resources and personnel"; Howlin et al., 2007, p. 476) are an actual barrier to implementation. Similarly, in natural environment settings, the financial cost of having staff implementing the protocols, as a "facilitator to address [student's] unique individual PECS needs in the classroom" (Travis and Geiger, 2010, p. 58) was also identified as a barrier.

3.3.1.1 Environmental characteristics and adaptations

This category includes the most common recurring themes that affect PECS implementation. The *Clinical Settings* category refers to identified comments that suggest that PECS is widely used in clinical settings and consequently its application to real-world environments is limited or not that widely researched: "data was collected either in early intervention centres, clinics, or integrated preschools" (Anderson et al., 2007, p. 174). Overall, one can say that PECS effectiveness stems from several studies, but these have predominantly been carried out in highly structured/clinical environments such as University clinics or highly structured home programs. It thus becomes evident that researchers need to concentrate on examining the effectiveness of the protocol in real-world settings and further aim to establish its ecological validity by implementing it with high fidelity in these settings.

The *incorporation of PECS and rigidity* category refers to the ease of incorporating PECS into the daily routines of each individual setting, Implementers in educational settings seem to struggle to find "ways in which PECS was actually implemented in the classroom" (Magiati and Howlin, 2003, p. 315). Similarly, it seems that PECS is typically implemented during snacks times; "four schools were teaching PECS during group sessions (including snack time)" (Magiati and Howlin, 2003, p. 312). This may be because sessions "are time limited (typically around 15 min) and are typically structured to encourage requesting" (Howlin et al., 2007, p. 476). On the contrary, some schools are incorporating PECS "in the classroom's activities throughout the day as well as providing teaching in individual sessions" (Magiati and Howlin, 2003, p. 312). It seems that school staff find it easier to include individual PECS "sessions in the daily class programme for the learners to communicate" (Travis and Geiger, 2010, p. 58). This also applies to clinical settings, like clinics and care homes as well as home programs, with PECS being implemented during "leisure and snack time in participant's home and play periods with peers during journal (writing/coloring in notebooks followed by play) and center activities (free play)" (Kravits et al., 2002, p. 226).

An emerging theme from the *PECS Opportunities* category suggests that the "number of communication opportunities offered within training sessions" varies (Tincani, 2004, p. 162). This was also evident through the quantitative analysis. Nevertheless, authors suggest that it is vital that "opportunities must be provided to use

PECS across settings and with many communication partners" (Thiemann-Bourque et al., 2016, p. 1144).

Environment adaptations also seem to constitute an important barrier in terms of PECS implementation. Some authors discuss how the learner's natural environment must be restructured in order to "create many communicative opportunities throughout a day for the child to practice and develop fluent communication skills" (Jurgens et al., 2018, p. 338) and suggest that failing to do so may cause learners to have "free access to their preferred items and, therefore, did not need to request the items." This further suggests that "preferred items [must be] isolated and put into a large plastic container out of the […] reach" (Greenberg et al., 2012, pp. 554, 546).

Stakeholder perceptions about PECS seems to be a recurring barrier to the protocol's implementation, that is if staff or therapists are not in agreement with the protocol's framework or goals then it is less likely that it will be implemented correctly. Similarly, it seems that implementers believe that PECS primarily targets learner's requesting for items, and it seems that they typically structure or choose sessions that "encourage requesting" (Howlin et al., 2007, p. 476).

The second emerging theme within this category is *Proximity and Availability of PECS book & materials*. This refers to staff perceptions that the PECS book should only be presented during a fixed "PECS" session: "all [learners] had PECS communication books in their cubbies (classroom storage units)" (Ganz et al., 2013a, p. 219)." This contingent access to the PECS book seems to create issues for some students: "continued using aggressive behaviour as a means of communication when the PECS book was not present" (Hu and Lee, 2019, p. 224). As some authors explain, the PECS book must "always be present, on a table or chair in the room" (Greenberg et al., 2012, p. 546) and staff must make sure that the "[it is] always available" (Jurgens et al., 2018, p. 340).

3.3.2 PECS training and consultation

The *need for implementers' PECS training* as well as the *mode of training* were two emerging themes that seem to affect the implementation of the protocol. In terms of implementer training, it is widely argued that "formal training in PECS is vital to ensure appropriate intervention [and] protocol should be followed" (Howlin et al., 2007, p. 476) and that because of the complexity of its error-correction procedures, it "requires thorough training to implement with high fidelity" (Ganz et al., 2008, p. 168). The need for extensive training in specific steps was also identified, as "certain steps may require more intensive training [for staff] to attain mastery" (Barnes et al., 2011, p. 1578). Overall, there is an agreement between researchers that the "lack of attention in the literature to the training issues associated with PECS implementation by school staff and parents is a gap that, hinders evaluation of PECS' effectiveness in real life contexts" (Ganz et al., 2013a, p. 211).

In terms of the *mode of PECS training*, the widely used two-day workshop format appears to be ineffective, as staff seem to "typically make errors on steps that were not covered in detail in the video or the verbal instructions" and while "brief instructions, manuals, and training videos may be preferable because of their low cost and time requirement, they may not be effective in teaching more complex skills, training staff in complex skills might require modelling and corrective feedback" (Barnes et al., 2011, p. 1578). It is thus likely that the typical "one-shot, workshop-training model is insufficient to support maintenance and generalization" (Ganz et al., 2013a, p. 219).

Follow-up and Consultation where "consultants recommend and demonstrate strategies for advancing children's use of PECS, monitor teachers' progress and provide systematic feedback on their implementation" seems to lead "to improved communication in children" (Howlin et al., 2007, pp. 475, 480). It also seems to facilitate the "(a) the provision of opportunities to use pictures to communicate, (b) the generalization of these skills to non-targeted contexts, and (c) the demonstration of basic treatment integrity" (Ganz et al., 2013a, p. 219). It seems that PECS consultation involving instructional coaching or behavioural skills training components like "instructions, modelling, rehearsal, and feedback" (Homlitas et al., 2014, p. 199) may be a facilitator to the protocol's implementation. Similarly, follow-up training sessions can help implementers "practice all responses" and facilitate "brushing-up" on their skills (Homlitas et al., 2014, p. 201).

3.3.3 Supervision and implementation fidelity

Staff supervision seems to be a facilitating factor as it "reduces variation" (Magiati and Howlin, 2003, p. 315) in terms of implementation, helps with on-the-spot training of staff who consistently miss "the same steps on the task analyses for each phase" (Barnes et al., 2011, p. 1579) and encourages implementers "to facilitate children's use of PECS in various sessions" (Howlin et al., 2007, p. 475) across the day. Supervision of implementation may also include "written summaries, agreed action points and future goals" with implementers (Howlin et al., 2007, p. 475). Supervision can also ensure *implementation fidelity* and seems to be a facilitator to the correct implementation of PECS, so that "any deviation from the procedures is immediately noted and corrected" (Stoner et al., 2006, p. 158). Finally, during supervision, data-based decision making can be promoted for troubleshooting potential implementation barriers. It is very common for some learners to have "some difficulty with training and, require procedural modifications" (Cummings et al., 2012, p. 44) or "have characteristics that require modifications to the standard PECS protocol in order to be successful" (Ganz et al., 2008, p. 167). During supervision, a trained professional with "expertise in troubleshooting stimulus control problems" (Cummings et al., 2012, p. 44) could help and train staff accordingly. Correct implementation of the protocol's teaching procedures also seems to facilitate implementation. Because PECS involves several "technical teaching procedures" (Jurgens et al., 2018, p. 338), it is vital for the training protocol to be followed precisely in order to meet the set targets.

3.3.4 Adherence to the PECS protocol

Reinforcer Assessment and Effectiveness was another important theme. During the initial phases of PECS, the protocol specifies "the use of highly preferred, individually motivating items" (Jurgens et al., 2009, p. 78) in order to reinforce requesting. Despite this, staff seem to mainly use "food items as reinforcing stimuli due to their motivating value" (Boesch et al., 2013, p. 483) or overuse the same items thus resulting in a "loss of potency" (Adkins and Axelrod, 2002, p. 265). It may well be the case that reinforcer effectiveness is a barrier to implementation as "free access to […] preferred items" (Greenberg et al., 2012, p. 554) as well as "poor reinforcer strength" (Tincani, 2004, p. 161) may weaken learners' acquisition of picture exchanges. Furthermore, the protocol suggests preference assessments should be carried out in order to identify individual reinforcing stimuli. Despite this, it seems that staff are not trained "to conduct a full preference assessment prior to PECS training to determine preferred,

non-preferred and neutral items" (Barnes et al., 2011, p. 1588). Repeated preference assessments throughout the intervention "'ensures that [learners are] interested in the items being presented during PECS training" (Greenberg et al., 2012, p. 544).

A number of factors seem to affect generalisation planning when implementing PECS, such as running the intervention "in natural school settings" (Ganz and Simpson, 2004, p. 398) or having "different implementers and different settings [and implanting] PECS in all the settings in which the [learner] is present" (Odluyurt et al., 2016, p. 160). Furthermore, the PECS protocol "is embedding generalization strategies within the teaching phases," that is, learners are taught to request different items with different communication partners across multiple settings (Thiemann-Bourque et al., 2016, p. 1144). Thus, following the protocol's [generalisation] progression and mastery criteria is an important factor that seems to be often bypassed during implementation.

3.4 Review question 2; stakeholders' views and experiences about PECS

RQ2 targeted stakeholders' views and experiences of implementing PECS and potential obstacles/barriers they faced. Overall, no published qualitative studies exploring PECS implementers' or users' experiences were identified by the search. Thirteen (28.3%) studies included a social validity measure, with all investigating parental views about PECS whereas five (10.9%) also included teachers or educational setting/clinic staff. Most parents reported positive experiences with PECS and subsequently viewed the protocol as feasible, acceptable, easy to implement and important in terms of improvement in communication (Jurgens et al., 2009; Boesch et al., 2013; Hu and Lee, 2019). Furthermore, some reported that PECS is an inexpensive intervention and that the time needed to prepare resources as minimal (Carson et al., 2012). Some parents reported difficulties in implementing the protocol at home while two of them reported the occasional lack of PECS symbols as a barrier to implementation (Greenberg et al., 2012).

Similarly, teachers reported positive experiences with PECS and incorporated the protocol in their classroom. Some teachers specifically reported that it had positive effect in terms of challenging behaviour within their classroom (Magiati and Howlin, 2003; Carre et al., 2009). No studies reported on the recipients' views or experiences about the intervention. The most common barriers to implementation included time restrictions in preparing resources and difficulties in accommodating different needs and PECS levels within the same classroom.

4 Discussion

4.1 Lack of homogeneity in reporting

The present review aimed to identify the potential facilitators and barriers to implementing PECS and how these affect the protocol's implementation and fidelity (RQ1). In addition, we sought to explore stakeholders' views and experiences of the protocol and what factors influence implementation (RQ2). During the data extraction and synthesis phase, it became evident that important features of PECS interventions are not systematically reported in the published literature. Because of this lack of homogeneity in the published literature, common factors affecting the implementation of PECS could not be systematically identified. Furthermore, key features of the protocol (reinforcer assessment, criteria for moving across phases, second prompter supporting Phases I-II, etc.) that inadvertently influence efficacy and replicability, were missing or poorly described.

Our systematic review's findings are in accordance with previous research about evidence-based practices, which suggested that most intervention studies fail to adequately report important implementation aspects and this in turn created an important blind spot in understanding "true" intervention effects (Mihalic, 2004; Durlak and DuPre, 2008; Glasziou et al., 2008). Hasson (2010) further argues that the failure to understand aspects related to implementation, introduces the risk of "implementation failure," which includes a potential failure to implement an intervention as intended. Thus, the present review's findings have significant implications in terms of PECS' true intervention effects and identification of implementation barriers and facilitators. This comes in accordance with Kelly and Perkins (2012) suggestion that to fully evaluate effectiveness, both PECS as an intervention and its implementation need to be fully considered and examined. PECS published studies for example could be reviewed using a customized checklist examining different quality indicators in terms of the protocol's important components and whether these have been reported or not.

4.2 Synthesised extracted data

Synthesised extracted data showed that most PECS interventions include a 1:1 (therapist to learner) ratio, with a second implementer being employed for PECS Phases I and II, as suggested by the manual. This may be regarded both as a facilitator and a barrier to implementation, as on the one hand, this mode of intervention delivery ensures a high implementation fidelity but on the other hand it may be impractical in real-world settings.

Preference assessments conducted prior to PECS training is another potential factor affecting PECS implementation. Undertaking preference assessments ensures that the learner is motivated, and saturation effects are avoided. This practice seems to facilitate implementation of the protocol, as evident from most of the studies reporting preference assessments prior to interventions. Despite this, only half of the studies explicitly reported how many different reinforcements were identified and employed for every participant.

Most reviewed studies only targeted specific PECS phases. Only six studies completed the training throughout all six phases. This makes drawing conclusions about barriers and facilitators to implementation difficult, as there seems to be minimal research in trainers completing all recommended phases. This issue, coupled with the fact that only half of the studies reported an intervention fidelity measure and some not reporting data, raises further questions. For example, what is the effect on learner outcomes of failure to adhere to the protocol, or implement all PECS phases? Perhaps this is the reason that few studies have attempted to study the protocol's implementation across all PECS phases. This reinforces previous suggestions by Flippin et al. (2010), Preston and Carter (2009), and Tincani and Devis (2011) who argued that the interpretation of PECS results remains

inconclusive, due to quantitative integrity data not being consistency reported.

The duration of the PECS intervention was reported in most studies and less than half reported the individual session duration or data was extracted from their graphs. Intervention and session duration were reported either in terms of time, or the total number of sessions or trials within a session, thus range was not possible to be calculated. Thus, the attempt to synthesise data in terms of intervention or session duration being a potential barrier or facilitator to PECS implementation was not feasible. The same applies for staff training in PECS and the amount of supervision they received throughout the intervention. For example, only ten studies indicated that their implementers received the official Pyramid PECS training. It therefore remains unclear how staff training and supervision affects the implementation of the protocol. This supports Magiati and Howlin's (2003) suggestion that PECS is implemented by untrained staff and may often be unsystematic and consistent.

Lastly, although the PECS protocol specifically targets generalisation, almost half of the reviewed studies have explicitly described a generalisation phase or components being incorporated in the intervention, either in terms of settings, participants or stimuli. Similarly, very few studies have programmed for PECS to be implemented in a way for generalisation to occur beyond a specific event (e.g., snack time, designated PECS session) or across environments or implementers. Greenberg et al. (2012), for example, suggest that true PECS efficacy also requires a robust assessment of the protocol's generalisation and several studies have included such procedures, including generalisation across time of day (Adkins and Axelrod, 2002), across people (Tincani, 2004; Tincani et al., 2006), across settings (Chambers and Rehfeldt, 2003), and across stimuli (Marckel et al., 2006).

Furthermore, Frost and Bondy's (2002) PECS training procedures, do include guidelines and suggestions for the implementation and generalisation of the protocol, as they further argue that to promote generalisation of the learned communicative exchange using the PECS system, instruction should take place in a variety of natural environments (e.g., home, school, community) and should occur during natural events and activities that take place throughout the course of a typical day (e.g., meals, snacks, play time, teaching time, playground opportunities). Thus, the findings of the present review and the associated identified lack of generalisation procedures, provide further support to Flippin et al.'s (2010) argument that published studies involving PECS interventions are lacking in terms of maintenance and generalisation. The identified lack of including a generalisation phase or components in the reviewed studies does raise a concern, as one could argue that while individuals may show improvement in communication within the structured PECS environment, the skills acquired might not transfer well to real-life communication situations. This raises concerns about the long-term effectiveness of PECS.

4.3 Low quality of reporting as a barrier to research questions

Overall, based on the low quality of reporting in terms of the aforementioned factors, it might be the case that these variables are actual barriers of PECS implementation in terms of time constraints and the response effort needed to tackle all the essential of the (relatively complex) PECS manual. This may be the reason for not being consistently reported.

Nevertheless, RQ1 has been partially answered, as no previous research has been conducted so far in terms of PECS implementation factors. No quantitative studies have manipulated potential factors to examine their implementation effects either acting as barriers or facilitators. The present review has identified some potential implementation factors through its data extraction procedure, but these have not been consistently reported in the included studies. This is a clear gap in PECS literature. Future meta-analyses on PECS must investigate the implementation dimensions within their sub-group analyses.

4.4 Barriers and facilitators arising from qualitative author comments

Different organisational factors seem to act as barriers to PECS implementation, including constraints in resources, time and staff constraints and financial costs for training and supervision. Similarly, potential environmental barriers include the type of setting, strategies for generalisation, incorporation of PECS into daily routines, number of PECS opportunities offered and required environmental adaptations. Effective staff training in PECS, follow-up and supervision are also identified as affecting implementation. Because of the complexity of the protocol's error-correction procedures, the mode of training, PECS consultation frequency, and follow-up training were also identified. Implementers training also inter-correlates with adherence to the protocol, implementation fidelity, reinforcer assessments and applying the generalisation procedures. It must be noted though that these factors were qualitatively extracted from previous authors comments and suggestions and should thus be interpreted with caution.

The identified categories seem to be in accordance with the suggested Implementation Components Framework (Fixsen et al., 2009), which offers a conceptual model targeting fundamental aspects necessary for implementation. The model suggests key competence drivers -the mechanisms that underpin and therefore facilitate implementation. These include the selection of implementers for the intervention, pre-intervention training, consultation and coaching, staff performance evaluation, decision support data systems and facilitative administrative support. Future research is thus needed to validate the findings and their alignment to Fixsen et al. (2009) suggested key competency drives.

4.5 PECS stakeholder views and experiences

In terms of stakeholders' views and experiences of implementing PECS (RQ2), once more, these factors are not consistently reported. Overall, no published qualitative studies explored PECS users' experiences. At present, we do not have any tools to collect non-verbal participants' views about interventions. The fact that they are not verbal does not mitigate the fact that they have the right to be involved in research and express their views in another way. Studies that did include a social validity measure, suggest that parents have positive perceptions and experiences with PECS, although no qualitative

studies have explicitly explored stakeholders' experiences of PECS. Overall, the present review's findings align with previous research that identified PECS as feasible, acceptable, easy to implement and important in terms of improving communication (Magiati and Howlin, 2003; Preston and Carter, 2009). The latter suggests that PECS is practical and achievable in real-world settings and that the protocol's implementation is not overly complex. Furthermore, PECS is well-received by different stakeholders and there is a positive perception of PECS as a significant approach to fostering communication skills. Lastly describing PECS as "easy to implement" implies that the system is user-friendly and can be put into practice without significant obstacles.

According to parents, potential barriers may include difficulties in implementing the protocol at home and the occasional lack of PECS symbols as a barrier to implementation. Educational staff report similar themes, including positive experiences with PECS and positive effect in terms of challenging behaviour within their classroom, in accordance with previous literature (Ganz and Simpson, 2004; Anderson et al., 2007; Jurgens et al., 2009). According to teachers, most common barriers to implementation, include time restrictions in preparing resources and difficulties in accommodating different PECS needs and levels within the same classroom. These are consistent with the content analysis findings.

4.6 Low quality reporting affects replication and clinical application

Partial reporting and description of PECS interventions inadvertently results in difficulties in replication to natural environment and real-world settings. This inconsistency in reporting, hinders a review of the barriers or facilitators to the implementation of PECS. The inconsistency in reporting the individual session duration for example, obstructs an attempt to assess whether contextual factors such as time available for the intervention is an actual facilitator or barrier to the PECS implementation.

Past research has already emphasised the importance of outlining the "core components" of interventions as part of implementation guidelines (Michie et al., 2009; Gearing et al., 2011). However, even in clinical practice, appropriate and sufficient reporting on intervention components remains an issue (Maggin and Johnson, 2015) and this was also evident through the present systematic review. While efforts are being made to improve the reporting of interventions, for example through the TIDieR checklist (Hoffmann et al., 2014), this is a fairly recent development. As the present systematic review found, many studies on PECS did not include sufficient descriptions of the intervention and how this was provided or implemented.

4.7 Limitations

The review findings must be considered with respect to the methodological limitations of the included studies. Although the inclusion criteria encompassed studies employing single-case design methodologies, there was a limited discourse on the fidelity of the intervention across them and a further notable inconsistency in the inclusion of all phases of PECS. There were thus potential limitations in identifying generic factors that may affect the protocol's implementation. Conclusions should thus be made with caution due to the limited number of RCT studies included in the review. A possible inclusion criterion of strictly including RCT studies would exclude a large literature base, from which valuable conclusions regarding potential implementations factors could be drawn. Finally, in most reviewed studies, the examination of potential barriers or facilitators that may affect the protocol's implementation was not the focus of the original study, which resulted in the need to make subjective judgments regarding possible implementation factors.

5 Conclusion

The present review aimed to identify how PECS has been implemented in previous scientific literature. During the review's data extraction and synthesis phase, it became evident that important features of PECS interventions are not systematically reported in the published literature. The identified implementation factors presented in the present study, were extracted from qualitative analysis (RQ1) of previous researchers' anecdotal remarks or from the social validity measures (RQ2). The identification of potential barriers or facilitators affecting the implementation of PECS is thus not currently possible.

The lack of consistent reporting of the implementation of PECS interventions in the research literature, is surprising. This review has shown that previous PECS literature has not been based on a consistent and inclusive framework that has clearly reported the independent variable (implementation of the PECS intervention). Subsequently, this brings into question the validity of some of the research findings as they cannot be compared and synthesised.

One can argue that if PECS researchers encountered any barriers to implementation, then they most likely had poor procedural integrity and therefore an unpublished manuscript. Therefore, the current research questions cannot be answered by reviewing the published literature through a systematic review and therefore another type of research is needed. Overall, the published literature on evaluations of PECS is not going to comprehensively reveal any implementation barriers and facilitators.

Further research could employ a qualitative approach to examine implementers' views and experiences and potentially provide further exploration or support for the identified implementation factors. Future research could also focus on developing standardised reporting guidelines specifically tailored to studies evaluating the effectiveness of PECS. This could involve collaborating with experts in field and the employment of research methodology to create a comprehensive checklist or framework for researchers to follow when designing, conducting, and reporting PECS studies. By promoting consistency and transparency in reporting, such guidelines could enhance the comparability and reproducibility of research findings, ultimately advancing our understanding of the effectiveness and implementation of PECS interventions.

Future research must thus clearly concentrate on potential PECS implementation factors from a different perspective and research design. These factors will have important positive impact on the implementation of PECS in different settings and potentially increase the protocol's suggested outcomes as previous reviewed have shown.

Prior to that, as researchers, we must increase the quality of reporting of PECS interventions' procedures.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

All authors contributed to the conception and design of the review, supported the interpretation of the data and provided final approval. AP and MA participated in the article search, study selection and data extraction phases. AP drafted the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1206410/full#supplementary-material

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