



PSYCHOLINGUISTIC INTERVENTIONS FOR ENHANCING SOCIAL INCLUSION OF NON-VERBAL STUDENTS THROUGH ASSISTIVE TECHNOLOGY

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Abstract

Many students with complex communication needs (CCN) who do not speak are often encountered in the classroom who have limited access to classroom discourse, peer interactions and decision making. Assistive technology and augmentative and alternative communication (AAC) can be used to enable expression, but this is not enough to ensure a lasting social inclusion. The objective of this protocol is to describe a psycholinguistic AAC intervention for early childhood and early-primary, classroom embedded, inclusive setting in Pakistan for 12-weeks. Methods: About 80 children ages 4-8 years across 20 classrooms will be randomly assigned to an intervention or usual-support condition across classrooms matched on grade level, race/ethnicity, age, and gender. The intervention is based on a combination of individualized no-, low-, and high-technology AAC, aided language modelling, core and culturally relevant fringe vocabulary, focused stimulation, recasts and expansions, visual narratives and play, milieu strategies, peer-mediated routines, and teacher and parent coaching. Independently produced communication, spontaneous initiations and responses, reciprocal turns, classroom participation, peer interaction, belonging, partner responsiveness, fidelity, feasibility and acceptability will be explored at baseline, midpoint, post-intervention and follow-up. The condition-by-time effects will be estimated using multilevel mixed-effects models. Reflexive thematic analysis will be applied to interviews, focus group discussions, observations and child friendly evaluation activities and will be displayed together in the mixed-methods approach. Discussion: The study does not maintain that inclusion is an automatic outcome of device ownership, but a relational and environmental one. It emphasizes autonomy in communication, culturally responsive vocabulary, cost-effective technologies, and continuous support from partners. Potential contribution: The protocol can contribute to inclusive-education policy, AAC services, teacher training, local-language resource development, and classroom practice which can be scaled up in Pakistan.

Keywords: augmentative and alternative communication; assistive technology; complex communication needs; psycholinguistics; peer-mediated intervention; social inclusion; early childhood education; Pakistan



Abbreviations

Abbreviation	Meaning
AAC	Augmentative and alternative communication
AT	Assistive technology
CCN	Complex communication needs
ECE	Early childhood education
GAS	Goal Attainment Scaling
SLP	Speech-language pathologist



1. Introduction

Communication is a developmental ability and a requirement for being in society. Children communicate in early childhood classrooms to gain access to play, to negotiate roles, share attention, to turn down unwanted play, to clarify, to show emotion, to tell stories, and to make friends. Students with limited or non-existent speech can have strong expressive and receptive, cognitive, and social skills, but are limited in their participation by environments that privilege speeded, spoken interaction. If peers and adults don't verbalize or respond to the other ways, the child may only be a passive observer, not an active member of the classroom community.

This phrase "non-verbal students" has been retained for the title, but is more accurately termed nonspeaking and minimally speaking students with complex communication needs (CCN). Children that are non-verbal often communicate with their body, their face, technology, objects and pictures, vocalization, sign, and gestures. The central issue then is not so much that the child is not communicating but rather that the social environment is not communicating to the child. The central problem is then not the lack of communication but rather a mismatch between the child's available modes and the expectations, knowledge, time, and resources of the social environment.

The right to communicate is also a right and a matter of dignity. Communication is broad defined in the Convention on the Rights of Persons with Disabilities and includes augmentative and alternative modes and demands inclusive education, readily available information, reasonable accommodation and appropriate support. Mehmood and Parveen (2024a) also define disability inclusion within the framework of the Islamic values of human dignity (karamah), compassion (rahmah), justice (adl), and social solidarity (takaful) in the Pakistani sociocultural context. These principles reinforce participation and self-determination as opposed to charitable or segregating responses.

Assistive technology is the use of products, services and systems that keep or enhance functioning. There are many different types of assistive technology that are related to communication that are considered under the umbrella of augmentative and alternative communication (AAC) and include unaided modes, low technology aids, and high technology speech-generating aids. But having a device isn't enough. A poor match, an inability to use the system, lack of access when doing regular tasks, limited vocabulary for requests, and lack of partner support can result in the inability to use AAC systems or to use the system in an effective manner. The public education sector in Pakistan has also identified that there are several recurring challenges in digital transformation, such as device costs, internet connectivity, device maintenance, power availability, and teacher preparation (Mehmood, Zaman, et al., 2025). These barriers impact high-technology AAC on a system level, and are directly applicable to the sustainability of high-technology AAC.

Psycholinguistic intervention is a stepping-stone for technology and participation. In this protocol, it means systematic practices that help the perception, comprehension, representation, retrieval, combination, and pragmatic utilization of language. The intervention doesn't treat AAC as a bunch of buttons that are to be trained separately. It offers easy access to the input through aided modeling, structured vocabulary around high frequency core words and personally meaningful fringe words, an expansion of syntax with recasts and contrastive models, opportunities for spontaneous, natural communication through time delay and responsive interaction, and structured opportunities for discourse through stories, visual scenes, and play.



Psycholinguistic research in Pakistan on speaking English-language learners has highlighted the influence of working memory, anxiety, self-efficacy, motivation, and psychological safety on their language participation and learning (Mehmood, Bano, et al., 2025; Mehmood, Jamal, et al., 2025; Mehmood, Zaheer, et al., 2025). The studies did not focus on AAC users, so intervention effects cannot be determined for children with CCN; however, they highlight a locally relevant principle that language learning is facilitated by factors other than language forms, including affect, confidence, social response, and cognitive load.

There is a crucial need to conduct a study on AAC in a context. The study on the EFL learning context in Pakistani schools has revealed that the teachers' preparation for English-medium education is inadequate, students' confidence in English is low, cultural issues and barriers are present, and parents' support is limited (Mehmood, Ziauddin, & Naseem, 2025). The studies in inclusive education have also highlighted teacher support, collaboration, and implementation support (Mehmood & Parveen, 2025), and the studies with special-education teachers have identified workload, administrative pressure, colleagues' acceptance, parent-related stress, and resource constraints (Mehmood & Parveen, 2024b). A viable intervention needs to thus support the child, the communication partner, and the organization in which communication takes place.

Study	Design/focus	Source-supported finding	Relevance to this protocol
Mehmood & Parveen (2024a)	Qur'an/Hadith thematic analysis of disability rights	Dignity, compassion, justice, solidarity, and non-exclusion support participation of persons with disabilities.	Rights-based rationale for communication autonomy, assent, and social inclusion.
Mehmood, Ziauddin, & Naseem (2025)	Qualitative study of English-medium instruction stakeholders	Teacher training, learner confidence, cultural barriers, and parental involvement affect implementation.	Supports partner training, family engagement, and culturally responsive language planning.
Mehmood & Parveen (2025)	Qualitative development and evaluation of a teacher support programme	Structured teacher support and staged implementation facilitate inclusive practice.	Supports coaching, rehearsal, feedback, and implementation planning.
Mehmood & Parveen (2024b)	Qualitative interviews with special-education teachers	Administrative demands, workload, colleague acceptance, parent-related stress, and financial constraints affect teachers.	Supports burden monitoring and context-sensitive fidelity interpretation.
Mehmood, Ain, et al. (2025)	Qualitative study of indigenous cultural practices in ECE	Cultural competence, local languages, community collaboration, and curriculum flexibility strengthen inclusion.	Supports culturally relevant vocabulary and co-design with families and communities.



Study	Design/focus	Source-supported finding	Relevance to this protocol
Mehmood, Bano, et al. (2025)	Mixed-methods psycholinguistic study with university English learners	Working memory, anxiety, cognitive load, confidence, and motivation influence language learning.	Provides indirect contextual support for psycholinguistic scaffolding and affect-sensitive teaching.
Mehmood, Zaman, et al. (2025)	Mixed-methods study of digital transformation in public schools	Device cost, connectivity, maintenance, electricity, and teacher preparation constrain technology use.	Supports low-tech backups, offline options, maintenance plans, and teacher support.
Mehmood, Fatima, et al. (2025)	Mixed-methods study of English competence and student development	Language competence was associated with critical thinking, empathy, confidence, and well-being.	Highlights the wider social-emotional value of communicative participation; indirect evidence only.
Mehmood, Zaheer, et al. (2025)	Mixed-methods study of motivation and sustainable language learning	Motivation, autonomy, affective filter, and contextualized tasks shaped retention and engagement.	Supports meaningful routines, choice, and identity-relevant communication opportunities.
Mehmood, Jamal, et al. (2025)	Mixed-methods study of psychological processes in English learning	Anxiety, cognitive load, self-efficacy, and psychological safety affected participation and equity.	Supports accessible input, emotional scaffolding, and psychologically safe interaction.
Mehmood, Rehman, et al. (2025)	Qualitative study of school leadership and inclusion	Empathy, open communication, shared decisions, recognition, and ethical leadership supported psychological safety.	Supports leadership engagement and school-climate assessment as implementation conditions.

Note. The English-language-learning studies involve speaking learners and are used as contextual or theoretical evidence, not as direct evidence of AAC effectiveness.

3. Theoretical and Conceptual Framework

The study combines four complimentary lenses. According to Vygotsky, the acquisition of language is an activity of social interaction with a mediator. AAC symbols, visual supports, and speech output are cultural tools which develop their meaning through the shared use with more knowledgeable and responsive partners (Vygotsky, 1978).

Light and McNaughton's (2014) model describes communicative competence in linguistic, operational, social and strategic skills, as affected by psychosocial factors and environmental supports and barriers.



Linguistic competence is about meaning, form; operational competence is about access, navigation; social competence is about rules, relationships; strategic competence is about coping with limitations and repairing failures.

The Human Activity Assistive Technology orientation focuses on the match between person (user), activity, and context and technology. The ecological theory of Bronfenbrenner (1979) takes analysis beyond the home, classroom, clinical services, school leadership, school policy, school culture, and school time. Combined, these perspectives suggest that the psycholinguistic input and meaningful practice will contribute to communicative competence, and that the partner responsiveness, peer opportunity, technology fit, psychological safety, and culturally relevant vocabulary will facilitate or prevent the transformation of communicative competence into social inclusion. **Figure 1. Editable conceptual model for the psycholinguistic AAC intervention**

Theoretical foundations	→	Intervention ingredients	→	Proximal mechanisms
Sociocultural mediation Communicative competence Ecological fit		AAC access Aided modeling Focused input Peer and partner coaching		Accessible input Reduced processing burden More opportunities Responsive interaction
		↓		
Moderators and implementation conditions	→	Communication outcomes	→	Social-inclusion outcomes
Technology fit Home language Motor/sensory access Fidelity Leadership and climate		Initiations and responses Message diversity Reciprocal turns Repair and autonomy		Participation Peer acceptance Belonging Friendship and agency

Note. This figure is constructed from editable Word table cells; labels, arrows, and shading can be modified directly.

Table 2. Operational propositions derived from the conceptual framework

Proposition	Statement
P1	Accessible, repeatedly modeled AAC input will increase comprehension, spontaneous communication, and message diversity.
P2	Partner wait time, recognition of all communication modes, and natural responses will increase independent initiations and reciprocal turns.
P3	Peer-mediated routines will increase shared activity, peer acceptance, and belonging beyond changes in language form alone.



Proposition	Statement
P4	Technology fit, cultural-linguistic relevance, psychological safety, and implementation fidelity will moderate intervention effects.
P5	Improvement in communication will not automatically imply inclusion; environmental barriers may remain and will be examined qualitatively.

4. Methods

4.1 Study Design and Protocol Status

This is an embedded explanatory mixed methods study design that features a matched-cluster quasi-experimental quantitative design. The 20 classrooms will be matched by region, school type, age group, and support available and then divided into intervention and usual support comparison classrooms. Repeated measures will be within Student and within Classroom. The qualitative component will be integrated during implementation and will be utilized to account for quantitative trends, feasibility, acceptability and variability within contexts.

This manuscript is a protocol for a prospective study. No data set was provided, nor are there any results reported. All tables marked as future results are NOT estimates or findings, but blank reporting templates.

4.2 Setting

The included ECE and early-primary education programmes in Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan and Islamabad Capital Territory will be considered for selecting sites. Settings can be public, low cost private, not-for-profit and inclusive special-mainstream partnership programs, as long as students are engaged in mainstream ordinary classroom routines with same age peers. Language ecology, infrastructure, electricity, internet access, specialists on-site, class size, leadership support for school, existing assistive technology will be documented on site.

4.3 Participants and Sampling

Planned sample: about 80 students age 4 - 8, CCN (approximately 40 students per condition). At least one classroom teacher, one peer partner and one parent or caregiver will be assigned to each student. Assessment, adaptation, and coaching will be provided by speech-language professionals or AAC specialists. Purposive maximum-variation sampling will be used for qualitative interviews to include different regions, languages, AAC modes, response patterns, and implementation conditions.

Table 3. Planned participant groups

Group	Estimated N	Selection/participation
Students with CCN	80	Eligible students across approximately 20 classrooms
Teachers and assistants	40	Primary classroom implementers
Peer partners	80	Classmates selected with assent; rotating opportunities where possible
Parents/caregivers	80	Home communication partners and qualitative informants
SLPs/AAC specialists	5-10	Assessment, coaching, troubleshooting, and fidelity consultation



Group	Estimated N	Selection/participation
School leaders	10-20	Implementation support, resource decisions, and context interviews

4.4 Eligibility, Recruitment, and Withdrawal

Students will qualify when there is a need for AAC support as determined by a multidisciplinary evaluation and speech does not reliably meet everyday communication needs. Intentional communication can be in any independent mode of production. Students will not be excluded because of a diagnosis, intellectual disability, hearing loss, vision loss, motor impairment, being multilingual, or using AAC now, unless an AAC participation plan can be developed.

The exclusion of students will only be made in cases where the educational placement is too short in duration to be followed up, consent is not obtained or where a safe and reliable access pathway could not be secured during the study period. Recruitment will happen via information sessions in school, teacher referral, parent information sessions, and screening by the researcher team. Participation is voluntary. Families and students can withdraw at any time, without penalty, and withdrawal will not impact current services or access to AAC.

4.5 Sample-Size Rationale

The proposed sample is not an efficacy trial but a feasibility and preliminary-effectiveness sample (multisite). It is expected to give estimates of recruitment, retention, variation in outcomes, clustering of classrooms, fidelity of implementation and plausible effect sizes for a future powered trial. The protocol was not a false power calculation due to the lack of reliable data for intraclass correlation and effect size estimates locally. The following will be reported clearly: precision intervals; variance components.

4.6 Intervention Development and Cultural Adaptation

Intervention materials will be co-developed with speech-language pathologists, ECE teachers, special educators, parents, disability advocates, and individuals who use AAC, as appropriate. Development will involve evidence review, classroom observations, vocabulary interviews, accessibility trials and pilot testing of routines and materials.

Vocabulary and visual materials will be provided in appropriate combinations of Urdu, English, Punjabi, Sindhi, Pashto, Balochi, Saraiki or in any local language. Symbols will be assessed for cultural appropriateness and appropriateness for age. Families will find words, names, foods, activities, relationships, places, religious/cultural events and topics that are personally meaningful to them and that will help them connect to their identities and participation.

4.7 Intervention Components and Dosage

The duration of the active phase will be 12 weeks. Intervention classrooms will engage in four routines of 25-30 minutes a week and will use partner strategies throughout the day. Coaches will focus on natural classroom experiences and systematically shift toward teachers, assistants, peers and families. Comparison classrooms will receive continued support as normal, with training materials provided following-up as ethically and practically possible.



Table 4. Intervention components and planned dosage

Component	Procedures	Dosage
AAC assessment and system preparation	Feature matching, access trials, core and fringe vocabulary, backup low-tech system, positioning and portability plan	Before Week 1; reviewed weekly
Aided language modeling	Adults and peers select relevant symbols while speaking; models exceed demands and follow the student's focus	Across all intervention routines
Focused linguistic input	High-density vocabulary exposure, recasts, expansions, contrastive models, question and comment forms	Four routines per week
Narrative, visual-scene, and play intervention	Dialogic reading, visual scenes, personal stories, pretend play, emotion and perspective language	At least twice weekly
Naturalistic milieu teaching	Environmental arrangement, time delay, choices, communication opportunities, and natural reinforcement	Embedded daily
Peer-mediated intervention	Peer orientation and strategy practice; cooperative play and shared projects; reciprocal turn support	Two or more peer routines weekly
Teacher/assistant coaching	Model-practice-feedback cycles, video reflection, troubleshooting, and implementation planning	Weekly 20-30 minutes
Family coaching	Home vocabulary selection, modeling in routines, maintenance and repair support	Biweekly contact plus optional home practice

Figure 2. Editable 12-week intervention timeline

Activity	Preparation	Weeks 1-2	Weeks 3-4	Weeks 5-6	Weeks 7-8	Weeks 9-10	Weeks 11-12	Follow-up
Assessment and system setup	■							
Teacher/assistant training	■	■						
Structured classroom routines		■	■	■	■	■	■	
Aided modeling throughout day		■	■	■	■	■	■	
Peer-mediated routines		■	■	■	■	■	■	
Weekly coaching		■	■	■	■	■	■	



Activity	Preparation	Weeks 1-2	Weeks 3-4	Weeks 5-6	Weeks 7-8	Weeks 9-10	Weeks 11-12	Follow-up
Family coaching		■		■		■		
Midpoint assessment				■				
Post-intervention assessment							■	
Maintenance/follow-up								■

Note. Filled cells indicate the planned active period. The timeline is an editable Word table.

4.8 Communication-Partner Training

Explanation, demonstration, rehearsal, feedback and class coaching will be used during teacher and assistant training. Core partner sequence will be: observe and follow the student's focus; ensure that the communication system is available and in place; gain attention in a respectful manner; model a few relevant symbols; pause long enough for a response; respect all intentional modes in communication; expand and/or recast without correction; respond with a natural consequence. Peers will get a short orientation that highlights waiting, shared control, friendship and repairing misunderstandings and is appropriate for their age.

4.9 Comparator Condition

Existing educational and communication supports will remain in place in comparison classrooms. The research team will update the existing availability of AAC, therapy, visual supports and teacher practices, as well as any changes that occur throughout the study. Staff training and use of intervention materials will be checked for contamination by asking if comparison staff receive related training and/or use intervention materials during the active phase.

4.10 Outcome Framework and Measures

Measures will relate to communication and social inclusion, in the individual, interactional, and environmental level. One overall score will not be considered to be valid evidence of inclusion. Accessibility, cultural appropriateness, feasibility, and psychometric appropriateness will be the bases for selection of measures. This content will be rated and piloted locally and have a clear scoring procedure.

Table 5. Constructs, indicators, and data sources

Construct	Indicator/measure	Source
Baseline communication	Communication Matrix stage, intentional modes, symbolic vocabulary, communicative functions	Assessment, parent/teacher interview, observation
Primary: functional communication	Rate of spontaneous, independently authored communicative acts across at least three functions	Coded video samples and structured probes
Primary: reciprocal peer engagement	Percentage of observed intervals with reciprocal peer interaction and shared activity	Coded peer-interaction observations
Message diversity	Unique meanings, functions, vocabulary types, and multi-symbol combinations	Coded communication samples



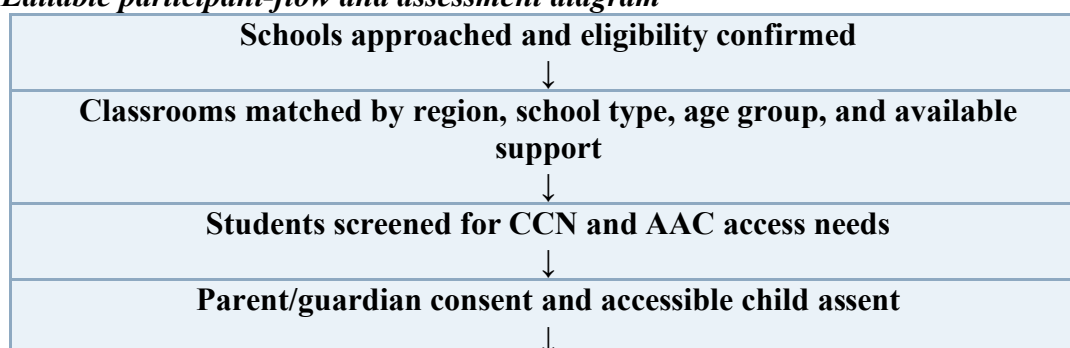
Construct	Indicator/measure	Source
Participation	Engagement in circle, play, snack, group task, transitions, and outdoor activities	Momentary and event-based observation
Social inclusion	Peer invitations, acceptance, shared affect, belonging ratings, and age-appropriate peer-network indicators	Observation, ratings, and child-accessible methods
Goal attainment	Individual communication and inclusion goals	Goal Attainment Scaling
Partner responsiveness	Modeling, wait time, response to multimodal communication, prompt intrusiveness, system availability	Fidelity and partner checklist
Acceptability and feasibility	Appropriateness, burden, usability, cultural-linguistic fit, sustainability	Surveys, interviews, and implementation logs
Technology fit and use	Availability, successful access, breakdowns, repair time, charging, portability, optional device logs	Weekly monitoring

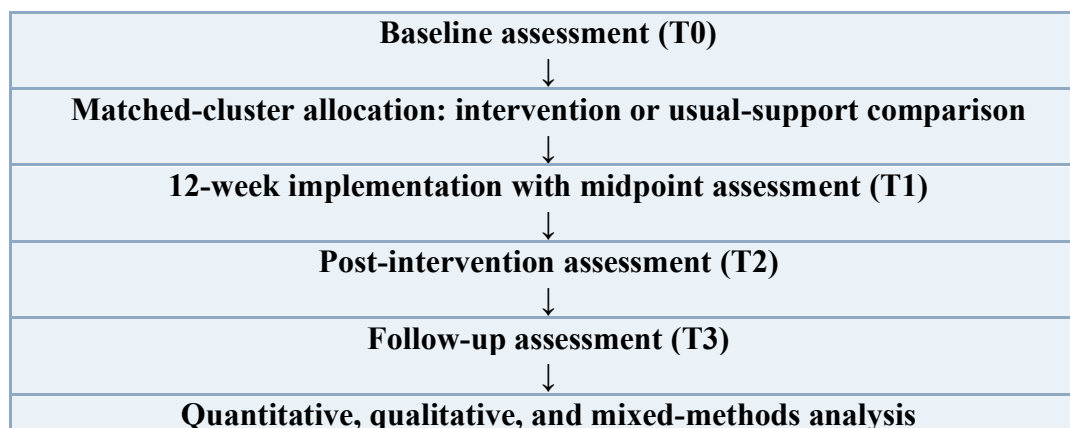
4.11 Data-Collection Schedule

Table 6. Measurement schedule

Time point	Week	Activities
T0: Baseline	Week 0	Profile, AAC assessment, observation, ratings, video, goal setting
T1: Midpoint	Week 6	Brief communication and participation probes; fidelity; feasibility interviews
T2: Post-intervention	Week 12	Full repeat assessment, interviews, focus groups, technology review
T3: Follow-up	Week 16	Maintenance and generalization observation, ratings, selected interviews

Figure 3. Editable participant-flow and assessment diagram





Note. Counts will be inserted after recruitment. This figure is editable in Word.

4.12 Intervention Fidelity, Feasibility, and Safety

Intervention Fidelity, Feasibility, and Safety will be assessed. Assessment of Intervention Fidelity, Feasibility, and Safety will take place.

The following will be assessed as to system availability, number and diversity of models, wait time, spontaneous communication, diversity of communicative functions, peer participation, natural reinforcement, and controlled prompts. A minimum of 20% of the sessions will be independently coded. For observational variables, inter-rater agreement will be reported.

Recruitment, consent, retention, completion of assessments, attendance at training, coaching time, device downtime, repair time, completion of routines, data completeness, and staff burden will be used as feasibility indicators. Brief ratings and interviews will be used to determine acceptability.

Adverse or unintended consequences may include: frustration, fatigue, sensory overload, device stigma, adult control of messages, withdrawal of current communication means and peer over-helping. Staff will receive training to stop or modify activities in response to refusal, to respect refusal and to record concerns. Any serious safeguarding concerns will be followed-up in line with institutional procedures.

4.13 Quantitative Analysis

Baseline profiles, missingness, fidelity, use of technology and outcome distributions will be described. Multilevel mixed-effects models with repeated measurements will be the primary analyses, with repeated measurements nested within students and students nested within classrooms. Fixed effects will be condition, time and condition-by-time interaction with baseline adjustment as needed. Student and classroom will be randomly specified; slopes will be considered if there is enough data to support this.

Linear mixed models will analyze continuous outcomes if the assumptions are reasonable to do so. The dispersion will be used to select between Poisson or negative-binomial mixed models for counting outcomes. Logistic mixed models will be used for binary outcomes. Effect estimates will be reported with 95% Confidence Intervals, and standardized effect sizes where appropriate. Secondary outcomes will be distinguished from the primary outcomes and addressed with a false discovery rate procedure or by careful interpretation.

Patterns of missing data and explanations for missing data will be explained. Under plausible missing-at-random assumptions, multiple imputation or maximum-likelihood estimation will be considered. Sensitivity analysis will be performed, comparing the key intention to treat style analysis with complete case and high fidelity exploratory analyses. Moderation and mediation analyses will be used to explore the effects but will be considered exploratory due to limited power.



Table 7. Planned statistical models

Outcome	Scale	Planned model	Core specification
Spontaneous independently authored acts	Count per standardized observation	Negative-binomial or Poisson mixed model	Condition, time, interaction; student and classroom random effects
Reciprocal peer engagement	Proportion or percentage of intervals	Binomial/logit or linear mixed model	Condition, time, interaction; baseline participation adjustment
Message diversity and communicative functions	Counts or diversity indices	Count or linear mixed model	Condition, time, interaction
Belonging and participation ratings	Continuous or ordinal scale	Linear or ordinal mixed model	Condition, time, interaction
Goal attainment	Standardized GAS score	Linear mixed model	Condition, time, interaction
Fidelity and responsiveness	Continuous/checkbox scores	Descriptive plus exploratory mixed models	Association with outcomes; not interpreted causally

4.14 Qualitative Data and Analysis

This will involve a variety of qualitative data including teacher interviews, parent interviews, professional interviews, school-leader interviews, peer focus groups or child-friendly conversations, researcher field notes, and selected video stimulated reflection. Students with CCN will be provided with alternative means of expressing a preference and/or experience using their own AAC system, symbol, rating scale, photographs, object choices, or independent yes/no response.

Reflexive thematic analysis will be carried out in four stages of familiarization, initial coding, developing themes, reviewing themes, defining themes, and synthesizing a narrative. Coding will take care of agency, competence, friendship, stigma, adult control, technology fit, multilingual identity, burden, sustainability, psychological safety, and unexpected consequences. A second analyst will question interpretations and scrutinise the analytic process; inter-rater reliability will not be used as an alternative to reflexive qualitative rigor.

4.15 Mixed-Methods Integration

The integration will be carried out by sampling, analysing and interpreting. Strategies for selecting contrasting qualitative cases (strong responders, minimal responders, and students with improved communication but not inclusion gains) will be driven by quantitative trajectories. Joint displays will identify convergence, complementarity, expansion and contradiction. Meta-inferences will make a clear statement about which inferences are being supported by quantitative evidence, qualitative evidence, or both.



Table 8. Mixed-methods joint-display template

Pattern	Quantitative evidence	Qualitative explanation	Integrated interpretation
Communication improves and inclusion improves	Positive condition-by-time effects	Partners describe more agency, reciprocity, and peer recognition	Convergent evidence of communication-to-inclusion pathway
Communication improves but inclusion does not	Language gains without peer-engagement change	Peer exclusion, adult control, inaccessible routines, or stigma remain	Environmental barriers limit translation of competence into inclusion
Inclusion improves with limited formal language change	Small language-score change; larger participation change	Multimodal participation and peer acceptance increase first	Formal language scores may underrepresent meaningful inclusion
Minimal change with high fidelity	Little outcome change despite strong implementation	Poor technology fit, inappropriate vocabulary level, or unmet access needs	Reassess theory of change and individualized matching
Minimal change with low fidelity	Little outcome change and limited implementation	Burden, training, infrastructure, or leadership barriers	Implementation failure cannot be interpreted as intervention ineffectiveness

4.16 Data Management and Quality Assurance

All participants will be issued a study code. Identifying information will be kept apart from the research information. Electronic data will be encrypted and access will be role restricted. Video files will be kept on secure institutional systems, sent via approved channels and deleted/archived based on ethics approval/consent. A data dictionary, coding manual, data version log and an audit trail will be maintained.

Standardized training in assessment and coding will be provided to assessors and coders. A subset of observations will be double coded, discrepancies will be reviewed and drift checks will be conducted throughout data collection. Data quality will be supported by range checks, logic checks and regular backups. Any protocol deviations will be recorded with reasons and potential consequences.

Table 9. Interpretation matrix for possible result patterns

Possible result pattern	Interpretation question	Program response
Communication and inclusion both improve	Did broader communication enable reciprocal relationships?	Maintain and scale the core package while checking equity across profiles.
Communication improves; inclusion does not	Are peers, routines, attitudes, or adult control still restricting participation?	Strengthen peer networks, leadership support, and environmental change.



Possible result pattern	Interpretation question	Program response
Inclusion improves; formal language scores change little	Did multimodal participation increase before symbolic language growth?	Retain multimodal outcomes and consider longer follow-up.
Minimal change with high fidelity	Was the system, access method, vocabulary, or linguistic level poorly matched?	Reassess feature matching, access, vocabulary, and goals.
Minimal change with low fidelity	Was burden, training, infrastructure, or leadership the primary barrier?	Simplify the package and increase implementation support.
Strong home gains but limited school gains	Are classroom pace, expectations, or system availability obstructive?	Improve school-home coordination and classroom access.

6. Discussion

The proposed study is based on the simple yet frequently overlooked idea: Communication technology supports inclusion when it changes interaction. While a speech-generating device can amplify the message, the student must also have words to speak, responders to take their turn, activities in which the message is important, and routines that ensure the system is available. The protocol is not a product, but an evaluation of an underlying theory of change through context sensitive adaptation, partner coaching, and psycholinguistic input and peer mediation.

The study builds upon previous research in a number of ways. It first makes social inclusion a co-primary domain with the functional dimension of communication. Second, it embeds well-known features - aided modeling, focused stimulation, naturalistic teaching, peer intervention, and partner instruction - in a manualized classroom package. Third, it explores the technology fit and implementation conditions in a multilingual and resource-constrained environment. Fourthly, it safeguards communication autonomy through the necessity to write communication messages independently and to provide access to consent. The mixed-methods approach has to be used because averages cannot account for why a system is still not used, why a peer relationship changes or why a family would choose one communication method in one circumstance and another in another. Qualitative data can bring to light issues of burden, stigma, ownership, identity, local language needs and psychological safety that are not reflected in outcome scores, as well as practical repair issues.

The findings are based on evidence that inclusive implementation requires teacher support, cultural relevance, family support, school leadership, psychological safety, and planning for technologies that are realistic, as seen in Pakistan-focused research (Mehmood & Parveen, 2025; Mehmood, Ain, et al., 2025; Mehmood, Rehman, et al., 2025; Mehmood, Zaman, et al., 2025). The protocol captures these lessons from the context into measurable implementation parts instead of seeing context as a general constraint.

6.1 Implications for Practice



The intervention is not for teachers to become technology specialists, but rather to provide them with practical routines. Keeping the system available, modeling a few meaningful symbols, waiting, responding to all intentional modes, giving reasons to communicate, supporting peers to interact naturally are the most important practices. The protocol for SLPs and specialists focuses on collaborative coaching, feature matching, vocabulary planning, access, and generalization out of therapy. It can help home vocabulary, multimodal communication, and continuity across settings for families.

6.2 Implications for Policy and Systems

Policy needs to provide services and products. Unused devices can be created when assessment, customisation, training, repair, and follow-up are not performed when procuring. The inclusive-education standards must include access to communication throughout the day, goals that are based on participation, local-language resources, teacher preparation and monitoring of the partner's responsiveness. Schools must also have leadership practices that enable coaches to have time, promote collaboration in problem solving, and minimize the fear of failure.

6.3 Strengths of the Protocol

- Multi-site design in a variety of educational and linguistic settings.
- Incorporation of communication, inclusion, implementation and stakeholder experience.
- Primary focus on autonomous responding to independent messages and understandable “yes.”
- Incorporation of low and high tech options, together with back-up and maintenance planning.
- The use of repeated measures, multilevel analysis, qualitative explanation, and joint displays.

6.4 Limitations

There may be preexisting differences between classrooms in the matched-cluster quasi-experimental design. The proposed sample is not homogeneous and may be underpowered for analyses of diagnosis-specific or moderator analyses. Teachers should not be blind to condition, a teacher's observations could change behaviour and some measures could need local adaptation. Follow-up may be too short to reflect long-term language development, device abandonment and friendship stability.

Variations will exist between schools due to infrastructure, leadership, workload, language and specialist availability. These differences are statistically significant and could present statistical issues when interpreting causality. The protocol tackles these shortcomings by quantifying fidelity and context, stating uncertainties, and refraining from making definitive efficacy claims.

7. Conclusion

Nonspeaking and minimally speaking students need more than just placement, goodwill, and an AAC device. They need to be provided with a language-learning system that is accessible to them, other people who share that system, and classrooms where they can participate in it with others. This protocol suggests an implementation-sensitive, psycholinguistically informed and culturally responsive intervention that views communication as an outcome of language learning and as a path to social membership. Whether it is created based on an increase in messages produced or an increase in agency, belonging, and participation in the school's daily life.



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