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Integrating articulation training for speech development into an individualized education program (IEP) for a deaf student: A case study

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Abstrak: This study aimed to examine the implementation of a school-based articulation training program integrated into an Individualized Education Program (IEP) to support speech development in a deaf student. The study was conducted at SLB Roudhotul Jannah, Bandung Regency, Indonesia, involving one fifth-grade deaf student. A single-case pre–post design was employed through several stages, including initial identification and assessment, IEP formulation, implementation of a six-session intervention, and evaluation conducted before and after the program. The results indicated improvements in respiratory control, oral motor coordination, and articulation accuracy of the target consonants (C, D, G, J, X, M, and P). The student also demonstrated improved clarity and completeness when reading short sentences, although difficulties remained when reading longer sentences consisting of four words or more. The findings suggest that structured articulation training emphasizing respiratory stability, articulator strengthening, and repetitive corrective practice can contribute positively to speech intelligibility outcomes in school-based special education contexts. Therefore, integrating articulation training into an IEP may be recommended as a structured approach to support oral communication development and academic participation among deaf learners.
Keywords: Articulation training, Speech development, Deaf student, Special education, Individualized education program

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Introduction

Articulation skills play a crucial role in speech production and affect speech clarity, particularly in an educational context. Articulation involves coordinated interaction between the respiratory, phonatory, and resonatory systems, requiring precise control of articulators such as the lips, tongue, jaw, and velum (Owens, 2016). Limited speech intelligibility can hinder classroom participation and affect students' learning., oral reading activities, and teacher–student interaction, thereby influencing academic achievement.

In deaf students, limited auditory input affects sound formation and articulation clarity. Without sufficient auditory feedback, monitoring and self-correction of speech errors become more difficult (Hallahan, Kauffman, & Pullen, 2019). Research on children who are Deaf and Hard of Hearing (DHH) indicates that articulation difficulties are closely related to both motor control and speech intelligibility outcomes (Stefánsdóttir et al., 2024). Furthermore, the International Classification of Functioning, Disability and Health (ICF) framework highlights that improvements in articulation should be understood not merely as isolated phoneme accuracy but as enhanced communicative functioning that supports participation and learning (Walshe et al., 2024).

Although systematic intervention is important, most studies are conducted in clinical settings, limiting its application in schools. in promoting spoken language development among children with

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hearing impairment. Evidence suggests that structured and intensive speech-focused programs contribute positively to language outcomes (Aaberg et al., 2025; Roberts, 2025). However, most of these studies are conducted within clinical or early intervention settings. Limited research has examined how structured articulation training is implemented directly within school-based instructional frameworks, particularly as part of an Individualized Education Program (IEP) in special education contexts.

In Indonesia, research on articulation in deaf students mainly focuses on visual media and phonetic techniques, leaving integrative approaches still limited (Rahmadhani & Z, 2023; Maspupah et al., 2024). Other studies have highlighted the importance of speech services in inclusive and special education settings (Saleh et al., 2024). Nevertheless, several gaps remain evident. First, existing interventions tend to focus narrowly on phoneme production without addressing respiratory control as a foundational physiological component. Second, outcome evaluations are often limited to isolated sound production, neglecting functional communication at the sentence level. Third, empirical evidence on the integration of articulation training within school-based IEP frameworks remains scarce.

Speech motor control literature underscores that stable respiratory support is fundamental for consistent and clear speech production, particularly in plosive and fricative consonants requiring adequate air pressure (Kent, 2000; McLeod & Crowe, 2024). This indicates that articulation training that ignores respiratory control may produce limited functional outcomes. Without sufficient breath control, articulation gains may not generalize to longer utterances. Therefore, an intervention approach that simultaneously targets respiratory stability, articulatory precision, and functional sentence reading is theoretically warranted. Although there have been developments, research on school-based articulation training that combines breathing, articulation, and speech performance is still limited. This limitation indicates a need for a more holistic and contextually embedded articulation intervention model within educational settings.

Accordingly, this study aims to examine the implementation of articulation training integrated into an Individualized Education Program (IEP) to support speech development in a deaf student. Using a single-case pre–post design, the study analyzes changes in respiratory control, target consonant articulation, and sentence reading performance following six structured intervention sessions. The study contributes by: (1) documenting a school-based articulation training model embedded within an IEP, (2) applying a simultaneous focus on respiratory and articulatory components, and (3) evaluating speech improvement beyond isolated phoneme production toward functional sentence-level performance.

Method

This study employed a single-case pre–post intervention design to examine changes in articulation skills following the implementation of a structured school-based articulation training program integrated into an Individualized Education Program (IEP), which is appropriate for analyzing individual-level changes in intervention-based research. This design allowed systematic comparison of the participant's performance before and after the intervention. The study was conducted at SLB Roudhotul Jannah, Bandung Regency, Indonesia.

The participant was a fifth-grade deaf student selected purposively based on initial assessment findings indicating specific articulation and respiratory difficulties, including unclear production of consonants (C, D, G, J, X, M, and P) and unstable breath control during oral reading, particularly in sentences of four words or more. In daily classroom interaction, the student primarily used oral communication supported by sign language.

Data were collected using structured assessment instruments developed based on the IEP framework and relevant speech therapy guidelines. The instruments included a respiratory control assessment measuring inhalation, breath retention duration in seconds, controlled exhalation, and performance in balloon-blowing and paper-blowing tasks. An articulation assessment checklist was used to evaluate consonant production accuracy, articulator placement, and air pressure control during plosive

and fricative sounds. In addition, a sentence reading rubric assessed breath stability, word completeness, and pronunciation clarity across two-word, three-word, and sentences consisting of four words or more. The same rubrics were administered during both pretest and posttest to ensure consistency of measurement.

The articulation training program was implemented across six structured sessions, progressively designed to support skill development from basic respiratory control to functional speech, targeting respiratory control, consonant accuracy, and sentence-level generalization, as summarized in Table 1.

Table 1. Structure of the Six-Session Articulation Training Program

Session	Focus of Training	Main Activities	Objective
1	Respiratory stabilization	Deep inhalation, breath retention, controlled exhalation, balloon and paper blowing	Establish basic breath control for speech production
2	Respiratory control & oral motor relaxation	Breathing drills + lip, tongue, jaw, and velum relaxation exercises	Improve coordination between respiration and articulators
3	Target consonant drills (C, D, G)	Guided articulator positioning, repetition with corrective feedback	Improve articulatory placement accuracy
4	Target consonant drills (J, X, M, P)	Repetition, modeling, controlled air pressure exercises	Strengthen consonant production consistency
5	Consonant generalization in short sentences	Reading two- and three-word sentences with guided breathing	Integrate articulation into functional speech
6	Sentence-level articulation practice	Reading ≥4-word sentences with breath control emphasis	Promote generalization to longer utterances

Data collection involved performance-based pretest and posttest assessments, direct observation during intervention sessions, documentation of activities, and semi-structured interviews with the classroom teacher and the participant's parents to support triangulation. Data analysis was conducted using descriptive and comparative analysis to identify changes between pretest and posttest performance across three domains. Improvement was identified based on increased breath duration, enhanced articulatory consistency, and greater sentence-level completeness and clarity, supported by observational notes and interview findings.

Results and Discussion

The results indicate measurable changes in three key domains respiratory control, consonant articulation, and sentence-level performance following the structured intervention. The main findings focus on changes in three domains: respiratory control, target consonant articulation, and sentence reading performance. At baseline, the participant demonstrated unclear consonant production (C, D, G, J, X, M, and P) and unstable breath control during oral reading, particularly when reading sentences consisting of four words or more.

1. Respiratory Control Improvement

Table 2 presents the comparison of respiratory control performance between pretest and posttest assessments.

Table 2. Respiratory Control (Pretest–Posttest Comparison)

Indicator	Pretest	Posttest	Change
Inhalation control	Shallow and rapid	Deeper and more controlled	Improved
Breath retention duration	±3 seconds	±6 seconds	+100%
Exhalation stability	Weak and unstable	Stable and sustained	Improved
Balloon blowing	Slight inflation	Larger, sustained inflation	Improved

Paper blowing	Unstable airflow	Consistent airflow	Improved

This improvement shows that breathing exercises help create more stable airflow, resulting in clearer articulation. The most notable change occurred in breath retention duration, which increased from approximately 3 seconds to 6 seconds, representing a 100% increase. This improvement shows better breath control for producing longer utterances. Exhalation became more stable, as reflected in improved balloon inflation and more consistent airflow during paper-blowing tasks. These findings indicate enhanced respiratory stability supporting clearer speech production.

2. Target Consonant Articulation

Table 3 summarizes changes in articulation accuracy of the target consonants.

Table 3. Target Consonant Articulation (Pretest–Posttest Comparison)

Consonant	Pretest	Posttest	Interpretation
/c/	Inconsistent, unclear	More accurate placement	Improved
/d/	Substitution/distortion	Clearer alveolar contact	Improved
/g/	Weak, low pressure	Stronger velar production	Improved
/j/	Unstable articulation	More consistent	Improved
/x/	Very weak, unclear	More audible but inconsistent	Partial improvement
/m/	Excess nasal resonance	Better lip closure	Improved
/p/	Weak plosive burst	Clear plosive release	Improved

Table 3 shows improvement in articulatory accuracy across all target consonants. These improvements indicate enhanced coordination between articulators and airflow control, which are essential for accurate consonant production. Plosive sounds such as /p/ demonstrated stronger burst release, while velar sound /g/ showed improved posterior tongue elevation and air pressure control. Although consonant /x/ improved in audibility, its production remained less consistent compared to other targets. This may be due to the higher articulatory complexity of /x/, which requires precise velar friction and controlled airflow. Overall, articulation gains were observed in placement accuracy and production stability.

3. Sentence Reading Performance

Table 4 presents changes in sentence reading performance across varying sentence lengths.

Table 4. Sentence Reading Performance (Pretest–Posttest Comparison)

Sentence Length	Pretest	Posttest	Improvement
Two-word sentences	Incomplete, unclear	Complete, clearer	Improved
Three-word sentences	Inconsistent completion	Mostly complete, clearer	Improved
≥ Four-word sentences	Unable to complete	Still unstable, partial completion	Limited improvement

As shown in Table 4, improvements in two- and three-word sentence reading, with better breath stability and clearer articulation, suggest that articulation gains began to transfer into functional speech contexts. However, performance on sentences consisting of four words or more remained inconsistent. The participant occasionally experienced breath depletion toward the end of longer utterances, indicating partial but not yet stable generalization of articulation and respiratory gains to extended speech contexts.

The findings of this study demonstrate that the integration of articulation training within an Individualized Education Program (IEP) contributed to measurable improvements in respiratory control, consonant articulation accuracy, and short-sentence reading performance. The most prominent change was observed in respiratory stability, particularly in the increased breath retention duration and more

controlled exhalation. This finding strengthens the theoretical argument that respiratory stability is not merely supportive but foundational in enabling consistent articulatory performance (Kent & Kim, 2023; McLeod & Crowe, 2024). Improved breath control likely facilitated clearer plosive and velar consonant production by enabling more consistent air pressure during articulation.

The improvement in target consonant accuracy further indicates that guided articulator positioning combined with repetitive corrective feedback enhances articulatory precision in deaf students. These findings align with research highlighting the importance of structured articulation-focused interventions in improving speech intelligibility among children who are Deaf and Hard of Hearing (Stefánsdóttir et al., 2024). Although consonant /x/ remained less stable compared to other targets, overall articulation consistency increased, suggesting that repeated motor practice strengthened articulatory coordination.

Importantly, articulation gains were not limited to isolated phoneme production but extended to functional speech contexts, particularly in two- and three-word sentence reading. This is consistent with the ICF framework, which emphasizes that improvements in speech should be evaluated in terms of communicative functioning rather than isolated sound accuracy (Walshe et al., 2024). However, performance on longer sentences remained unstable, indicating that generalization to extended utterances requires continued training and sustained respiratory control.

The integration of articulation training into the student's IEP shows that it can be effectively applied in school settings. Unlike many prior studies conducted in clinical or early intervention settings (Aaberg et al., 2025; Roberts, 2025), this intervention was embedded directly within a school-based instructional framework. This suggests that structured articulation training can be feasibly implemented within special education classrooms and aligned with academic objectives.

Nevertheless, this study has limitations. The intervention involved only one participant and was conducted over six sessions, which may limit generalizability and long-term stability of outcomes. Future research should involve multiple participants, extended intervention duration, and follow-up assessments to examine retention and broader generalization of articulation gains. Overall, the findings provide preliminary evidence that a structured, school-based articulation training program integrated into an IEP can enhance speech development in a deaf student, particularly in respiratory stability and short-sentence intelligibility.

Conclusion

This study demonstrates that integrating a structured articulation training program into an Individualized Education Program (IEP) can positively support speech development in a deaf student. Improvements were observed in respiratory stability, consonant articulation accuracy, and short-sentence reading performance following six intervention sessions. The findings highlight the importance of combining respiratory control training and articulatory drills to enhance speech intelligibility within school-based special education settings.

Although improvements were more evident in short utterances, performance on longer sentences remained inconsistent, indicating the need for continued and sustained intervention. As a single-case study conducted over a limited duration, the findings provide preliminary evidence rather than broad generalization. Future research involving multiple participants and extended intervention periods is recommended to examine long-term stability and generalization effects.

Overall, the study supports the feasibility of embedding articulation-focused speech development within IEP frameworks to promote functional communication outcomes in deaf students.

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