Enhancing Vocabulary Mastery Through Digital Image Media and Project-Based Learning: A Classroom Action Research with Third-Grade Students with Speech Disorders

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Abstract
This classroom action research investigated the effectiveness of digital image media based on Project-Based Learning (PBL) in enhancing vocabulary abilities among third-grade students with speech disorders. Four students aged 8-9 years at YPPSB 3 Elementary School, Sangatta Utara, participated in this study conducted across three cycles following the Kemmis and McTaggart model. Data were collected through structured observations, vocabulary tests (pretest and posttest), and documentation of learning activities. Results demonstrated significant progressive improvements in students' vocabulary abilities. Mean scores increased from 48.94% at pre-action to 54.53% in Cycle I, 71.41% in Cycle II, and 82.31% in Cycle III, representing a total improvement of 33.37%. By Cycle III, 75% of students achieved the "Developing Very Well" category, while 25% reached "Developing as Expected," with no students remaining in lower developmental categories. The intervention enhanced both receptive abilities (listening and comprehension) and productive abilities (speaking and retelling). Digital image media provided concrete visual stimuli supporting word-meaning associations, while the PBL approach fostered active engagement, collaboration, and contextual learning. The combination proved effective in creating enjoyable, meaningful, and inclusive learning experiences for children with speech disorders, confirming that multimodal technology-enhanced instruction addresses complex communication needs and narrows vocabulary gaps typically widening over time in this population.

INTRODUCTION

Vocabulary acquisition represents a fundamental cornerstone in language development, particularly for children with speech disorders who face significant challenges in both comprehending and utilizing linguistic elements effectively. Mastery of vocabulary extends beyond mere language proficiency indicators; it serves as the foundation for constructive and productive communication in both home and educational environments (Steele & Mills, 2011). Children experiencing language limitations encounter substantial difficulties in expressing their thoughts and emotions, consequently leading to diminished self-confidence and compromised academic achievement (Simon & Rosenbaum, 2016). Lowe et al. (2022) emphasized that vocabulary deficits in children with language disorders significantly impact their ability to participate in classroom activities and social interactions. Bishop et al. (2017) established through multinational consensus that developmental language disorders have sustained social and educational impacts requiring specialist intervention. These children typically demonstrate passive behavior in learning processes, struggle with concentration, and exhibit reduced confidence when participating in classroom literacy activities. Rice and Hoffman (2015) revealed that language gaps between children with spoken language disorders and their peers without such disorders widen over time, particularly in vocabulary acquisition. McKean et al. (2017) demonstrated that these early language difficulties predict later cognitive, language, and psychosocial outcomes,

while Clegg et al. (2005) found that developmental language disorders have long-term consequences extending into adult life, creating a significant developmental divide in language skills and life opportunities.

Recent evidence suggests that the majority of school-age children have not demonstrated significant language development progress. Norbury et al. (2016) found that the prevalence and clinical presentation of language disorders are substantially influenced by children's communication abilities, affecting approximately 7% of primary school-age children. Steele and Mills (2011) highlighted the critical need for evidence-based vocabulary intervention practices specifically designed for primary school-age children with language impairment. Children with speech disorders in classrooms frequently resort to body language such as nodding, pointing, or facial expressions to respond to teacher instructions, displaying a marked tendency to avoid verbal responses. Boyle et al. (2007) conducted a randomized controlled trial demonstrating that different service delivery models for vocabulary intervention show varied effectiveness. Cirrin et al. (2010) systematically reviewed evidence showing that when learning processes remain dominated by conventional methods such as monotonous textbook usage, expanding vocabulary becomes increasingly challenging for children with speech impediments. Throneburg et al. (2000) compared service delivery models and found that interactive approaches significantly outperformed traditional classroom-based vocabulary instruction.

Several studies have demonstrated the effectiveness of visual media, particularly digital images, in vocabulary development. Habibillah and Fahyuni (2024) found that implementing image media significantly enhanced vocabulary mastery and learning outcomes among elementary school students. Faradisa and Fitriani (2023) confirmed that picture media utilization substantially improved vocabulary acquisition, while Utami and Rahman (2020) established that image media effectively enhanced children's vocabulary mastery through concrete visual representation. Napitupulu et al. (2023) and Anita et al. (2024) validated the effectiveness of image media for vocabulary introduction. Safiah (2025) revealed that digital learning media based on educational games significantly facilitated vocabulary mastery. International research provides robust support, with Smeets et al. (2014) demonstrating that electronic storybooks with visual elements effectively support word learning in children with severe language impairments, particularly when extraneous sounds are removed. Lowman and Dressler (2016) found that multimedia storybooks combining text, pictures, and animation produced greater vocabulary gains than reading alone. Best (2005) investigated digital interventions showing promising results for children with word-finding problems. Jing et al. (2023) conducted a comprehensive meta-analysis revealing that educational screen media with visual aids shows positive correlations with early vocabulary development when content is specifically designed for learning. Paivio (2007) theorized that visual aids are critical to vocabulary learning through dual coding of verbal and visual information in memory systems. Banoth & Muthyala (2025) confirmed that preschoolers taught new words with pictorial support demonstrate better learning and retention, while Constantinidou and Evripidou (2012) found that visual presentation modalities enhance vocabulary acquisition. Wasik et al. (2016) systematically reviewed research confirming that visual elements in book reading facilitate vocabulary development across childhood.

Despite these promising findings, the utilization of visual media for children with speech disorders remains considerably limited. The advancement of technology has enabled innovative collaboration between digital image media and Project-Based Learning (PBL) approaches. Azizi et al. (2023) demonstrated that PBL models supported by literacy media effectively enhanced students' vocabulary acquisition. Yunita et al. (2022) established that project-based learning through vlog creation significantly improved preschoolers' vocabulary mastery. Prayogo (2024) confirmed PBL's positive influence on vocabulary mastery, while Kimsesiz et al. (2017) validated PBL's effectiveness in teaching vocabulary to young learners including preschool children. Kholis and Aziz (2020) substantiated that project-based learning significantly enhanced vocabulary achievement, and Sudirman and Meriyani (2025) corroborated these findings across educational levels. Thomas (2000) and Krajcik and Blumenfeld (2006) explained that PBL creates active, contextual, and engaging

learning atmospheres by encouraging students to participate collaboratively in solving authentic problems. Grant (2011) found that students in PBL environments demonstrate enhanced engagement and deeper learning. Kokotsaki et al. (2016) reviewed literature confirming PBL's effectiveness across diverse learner populations, making it particularly suitable for children who struggle with traditional verbal instruction. Intepe-Tingir & Whalon (2023) demonstrated that educational programs with targeted vocabulary can improve language learning even in children with autism spectrum disorder. Rice et al. (1992) showed that children learn vocabulary effectively from educational media when content is appropriately designed, while Linebarger and Walker (2005) found that programs with strong narrative structures positively associate with vocabulary development. Schmidt et al. (2009) emphasized that educational content provides rich linguistic input crucial for vocabulary learning.

Field observations at one elementary school revealed that third-grade students with speech disorders exhibited low language examination scores, limited participation in literacy activities, difficulty comprehending vocabulary meanings, and minimal responses to teachers' verbal instructions. This situation underscores the urgency of implementing more contextual and visual learning strategies capable of stimulating interest and engagement among students with speech disorders in vocabulary development processes.

This research aims to examine the initial conditions of vocabulary abilities among third-grade students with speech disorders, analyze instructional improvements through project-based digital image media, and evaluate its effectiveness in enhancing vocabulary mastery. Theoretically, this research contributes to enriching references in technology-based visual vocabulary learning development, particularly for children with communication impediments. Practically, the findings provide valuable insights for teachers in designing more innovative and inclusive learning strategies, while offering considerations for schools to provide instructional media supporting individual and comprehensive student learning needs.

METHODS

This study employed a Classroom Action Research (CAR) methodology with mixed methods approach to address the low vocabulary abilities of third-grade students with speech disorders through digital image media based on Project-Based Learning. The CAR framework, following the Kemmis and McTaggart model, incorporated four iterative phases within each cycle: planning, acting, observing, and reflecting. The research was conducted across three cycles at YPPSB 3 Elementary School in Sangatta Utara, with each cycle consisting of two instructional sessions. A pre-action phase was initially implemented to identify baseline vocabulary abilities, and subsequent cycles were refined based on previous findings to achieve progressive and sustained improvement in students' vocabulary mastery.

The research participants comprised four third-grade students aged 8 to 9 years who had been formally identified with speech disorders and were enrolled in an inclusive education program. Purposive sampling was employed based on specific criteria: demonstrated interest in digital visual media, ability to comprehend verbal instructions, significant difficulties in vocabulary mastery, and absence of hearing impairments. This targeted selection ensured that participants could meaningfully engage with the digital image media intervention while representing the population of elementary students experiencing speech-related communication challenges.

Data collection utilized multiple instruments to ensure comprehensive assessment of vocabulary development. Structured observation checklists documented both teacher implementation quality and student engagement during instructional activities, capturing receptive and productive language behaviors. Vocabulary assessment tests administered as pretests and posttests measured students' abilities across multiple dimensions including listening comprehension, word repetition, visual identification, vocabulary articulation, and written expression. The assessment instruments underwent content validity evaluation by education experts to ensure alignment between measured indicators, learning objectives, and test items. Documentary evidence including field notes and photographic

records of learning activities supplemented observational data. The vocabulary assessments specifically evaluated two primary domains: receptive abilities encompassing listening and comprehension skills, and productive abilities involving active vocabulary usage through speaking and retelling activities.

Data analysis integrated both quantitative and qualitative approaches to provide comprehensive evaluation of intervention effectiveness. Quantitative data from pretest and posttest scores were analyzed using percentage formulas to measure achievement levels and improvement rates. The mean improvement was calculated by comparing average scores before and after each intervention cycle ($\Delta\bar{X} = \bar{X}final - \bar{X}initial$) to determine treatment efficacy. Student performance was categorized into four developmental levels: Not Yet Developing, Starting to Develop, Developing as Expected, and Developing Very Well. Qualitative data underwent systematic analysis through data reduction, presentation, and conclusion drawing processes. Observational and documentary data were interpreted descriptively to examine learning dynamics, student participation patterns, and behavioral changes throughout the intervention. These qualitative insights informed reflective practices and guided instructional modifications for subsequent cycles. The success criterion was established as achieving at least 75% of students reaching the "Developing as Expected" category or higher in vocabulary mastery indicators on posttest assessments, ensuring that the intervention produced meaningful and measurable improvements in students' communication abilities.

RESULTS AND DISCUSSION

Results

The implementation of digital image media based on Project-Based Learning (PBL) demonstrated progressive improvements in vocabulary abilities among third-grade students with speech disorders. The research was conducted over approximately three months, encompassing pre-action assessment and three complete intervention cycles. Each cycle consisted of two instructional sessions delivered twice weekly with a duration of 35 minutes per session, followed by comprehensive data collection through observations, field notes, learning outcome tests, and subsequent analysis and reflection on obtained results.

The pre-action assessment established baseline vocabulary competencies among participating students, revealing concerning initial performance levels. As presented in Table 1, the findings indicated that vocabulary abilities were predominantly at early developmental stages. Three students (75%) were categorized as Starting to Develop (MB) with scores ranging from 30.00% to 48.75%, while only one student (25%) achieved the Developing as Expected (BSH) category with a score of 71.25%. The overall mean vocabulary ability at this stage was 48.94%, reflecting inadequate mastery that necessitated targeted intervention through contextually rich and engaging learning experiences to achieve significant improvement in vocabulary acquisition.

Table 1. Pre-Action Vocabulary Test Results

Subject	Total Score	Percentage	Category
AJN	57	71.25%	BSH (Developing as Expected)
CDB	39	48.75%	MB (Starting to Develop)
MNA	35	43.75%	MB (Starting to Develop)
RASP	24	30.00%	MB (Starting to Develop)

Following the implementation of PBL-based instruction with digital image media, Cycle I demonstrated initial improvements in students' vocabulary abilities. Table 2 illustrates the distribution of achievement following the first intervention cycle. Two students (50%) reached the BSH category with scores of 75.00% and 53.00%, while the remaining two students (50%) remained in the MB category with scores of 48.12% and 40.00%. The mean score increased to 54.53%, representing a 5.59% improvement from the pre-action phase. Although this indicated positive momentum, the

results revealed that the target of 75% of students achieving BSH category or higher had not been met, necessitating continued intervention with enhanced instructional strategies in subsequent cycles.

Table 2. Cycle I Achievement Distribution

Subject	Session 1 Score	Session 2 Score	Total Score	Percentage	Category
AJN	59	61	120	75.00%	BSH
CDB	42	43	85	53.00%	BSH
MNA	36	41	77	48.12%	MB
RASP	26	38	64	40.00%	MB

Cycle II marked substantial progress in learning outcomes, demonstrating more significant and equitable improvements across participants. As shown in Table 3, three students (75%) successfully achieved the BSH category with scores ranging from 68.75% to 90.63%, while one student showed considerable improvement reaching 54.38% though remaining in the MB category. Notably, one student advanced to the Developing Very Well (BSB) category with a score of 90.63%. The mean score for all participants reached 71.41%, reflecting a 16.88% increase from Cycle I and a 22.47% improvement from baseline. These results indicated that the project-based approach supported by visual media generated positive and more evenly distributed impacts on students' vocabulary development, with the intervention target being achieved at this stage.

Table 3. Cycle II Achievement Distribution

Subject	Session 1 Score	Session 2 Score	Total Score	Percentage	Category
AJN	66	79	145	90.63%	BSB
CDB	53	57	110	68.75%	BSH
MNA	55	60	115	71.88%	BSH
RASP	42	45	87	54.38%	BSH

Cycle III demonstrated the highest achievement levels throughout the research period, confirming the sustained effectiveness of the intervention approach. Table 4 presents the final achievement distribution, revealing that three students (75%) attained the BSB category with scores exceeding 80%, while one student (25%) reached the BSH category with a score of 66.88%. Critically, no participants remained in lower developmental categories, indicating comprehensive improvement across all subjects. The overall mean score increased to 82.31%, representing a 10.90% gain from Cycle II and a total improvement of 33.37% from the pre-action baseline. This progressive enhancement affirmed that implementing digital image media within the PBL framework effectively and sustainably improved vocabulary abilities among students with speech disorders, achieving both individual growth and collective instructional success.

Table 4. Cycle III Achievement Distribution

Subject	Session 1 Score	Session 2 Score	Total Score	Percentage	Category
AJN	78	79	157	98.13%	BSB
CDB	62	66	128	80.00%	BSB
MNA	68	70	138	86.25%	BSB
RASP	51	56	107	66.88%	BSH

The progression of mean vocabulary scores across all intervention phases is graphically illustrated in Figure 1, providing a clear visualization of the continuous improvement trajectory. The graph demonstrates a steady upward trend from the pre-action phase (48.94%) through Cycle I (54.53%), Cycle II (71.41%), to Cycle III (82.31%). This consistent ascending pattern confirms the cumulative positive effects of sustained intervention, indicating that the combination of digital visual stimuli and

project-based learning methodologies progressively strengthened students' vocabulary acquisition and retention capacities.
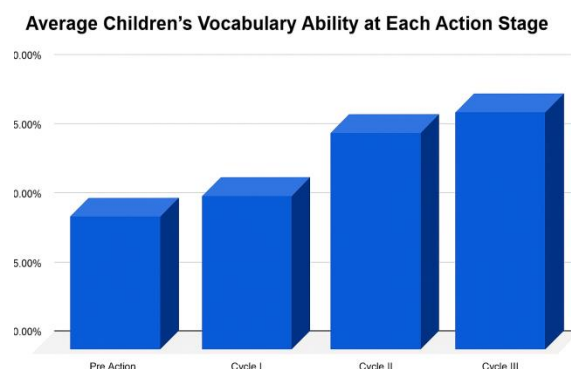

Figure 1. Mean Vocabulary Ability Development Across Intervention Phases

Beyond quantitative improvements, the research revealed significant shifts in the distribution of developmental categories across intervention phases. Table 5 presents the categorical distribution changes from pre-action through Cycle III. During the pre-action phase, 75% of students were categorized as MB with only 25% at BSH level. Following the complete intervention sequence, Cycle III results showed a remarkable transformation with 75% of students achieving BSB status and 25% at BSH level, with no students remaining in lower developmental categories. This categorical progression demonstrates not only improved academic performance but also successful movement of nearly all participants toward expected developmental benchmarks, confirming the intervention's capacity to promote equitable learning outcomes across diverse learner profiles.

Table 5. Distribution of Vocabulary Development Categories Across Intervention Phases

Category	Pre-Action		Cycle I		Cycle II		Cycle III	
	n	%	n	%	n	%	n	%
BB	0	0	0	0	0	0	0	0
MB	3	75%	2	50%	0	0	0	0
BSH	1	25%	2	50%	3	75%	1	25%
BSB	0	0	0	0	1	25%	3	75%

Figure 2 provides a visual representation of these categorical transformations, illustrating the progressive shift from lower to higher developmental levels across the intervention timeline. The stacked bar chart clearly depicts the elimination of MB classifications and the substantial increase in BSB attainment by Cycle III, offering compelling visual evidence of the intervention's effectiveness in elevating students' vocabulary competencies to age-appropriate and educationally functional levels.
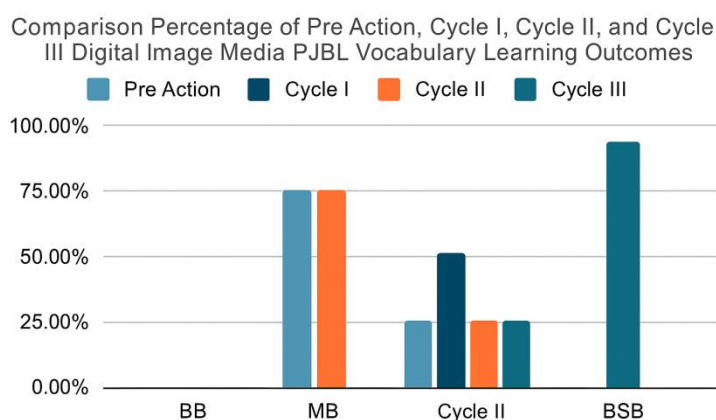

Figure 2. Distribution of Vocabulary Development Categories Across Intervention Phases

Discussion

The implementation of digital image media based on Project-Based Learning (PBL) yielded substantial positive contributions to vocabulary development among students with speech disorders, evidenced through both quantitative performance gains and qualitative categorical progressions. At the pre-action baseline, students' vocabulary abilities were at relatively low levels with a mean achievement of 48.94%, and the majority classified as Starting to Develop. This initial condition reflects the documented challenges that children with speech disorders face in vocabulary acquisition, consistent with findings from Lowe et al. (2022) who emphasized that vocabulary deficits significantly impair classroom participation and social interaction. Bishop et al. (2017) similarly noted that developmental language disorders have sustained educational impacts requiring specialized intervention strategies beyond conventional instructional approaches.

Following Cycle I implementation, the mean score increased to 54.53% with more balanced categorical distribution. Students began demonstrating enhanced abilities to recognize and identify words through visual stimuli, though spontaneous usage remained limited. This initial improvement aligns with Smeets et al. (2014) who found that electronic storybooks with visual elements effectively support word learning in children with severe language impairments when properly designed. The continued intervention through Cycle II produced more significant results, elevating the mean achievement to 71.41%. Students exhibited increased confidence in articulating and applying newly learned vocabulary through digital image media, confirming Lowman and Dressler's (2016) findings that multimedia combining text, pictures, and animation generates superior vocabulary gains compared to traditional methods. This progression demonstrates that project-based learning providing authentic experiences can strengthen language acquisition naturally and contextually, supporting Krajcik and Blumenfeld's (2006) theoretical framework that PBL creates active, contextual learning environments particularly beneficial for students struggling with traditional verbal instruction.

The most optimal improvement occurred during Cycle III, where the mean score reached 82.31%, representing a total increase of 33.37% from baseline. The majority of students achieved the Developing Very Well category, with comprehensive progress across all participants. This substantial advancement supports Paivio's (2007) dual coding theory, which posits that visual aids facilitate vocabulary learning through simultaneous processing of verbal and visual information in memory systems. Banoth & Muthyala (2025) corroborated that children taught vocabulary with pictorial support demonstrate superior learning and retention, findings directly reflected in the sustained improvements observed throughout this study. The categorical distribution transformation further substantiates intervention effectiveness, with 75% of students advancing to BSB status by Cycle III, eliminating all lower developmental classifications. This equitable improvement pattern validates Jing et al.'s (2023) meta-analytic conclusion that educational screen media with appropriate visual aids positively correlates with vocabulary development when content is specifically designed for learning purposes.

The PBL approach complemented these visual learning benefits by providing exploration, collaboration, and reflection opportunities within the learning process. Through projects designed according to students' needs and interests, participants became more engaged and motivated to use language actively. These findings align with Grant's (2011) research demonstrating that students in PBL environments exhibit enhanced engagement and deeper learning outcomes. Kokotsaki et al. (2016) reviewed extensive literature confirming PBL's effectiveness across diverse learner populations, particularly for those experiencing difficulties with conventional instructional methods. The success of this intervention also resonates with Rice et al.'s (1992) seminal work showing that children effectively learn vocabulary from educational media when content is appropriately structured, and Linebarger and Walker's (2005) finding that programs with strong narrative structures positively associate with vocabulary and expressive language development.

Furthermore, the progressive improvement trajectory observed across cycles contradicts Cirrin et al.'s (2010) systematic review noting limited evidence for specific service delivery models, instead demonstrating that carefully designed multimodal interventions combining visual technology with project-based pedagogy can produce measurable and sustained outcomes. The intervention's success in moving students from predominantly MB to predominantly BSB categories addresses Throneburg et al.'s (2000) concerns about traditional classroom-based vocabulary instruction, offering an evidence-based alternative that leverages both technological affordances and constructivist learning principles. Schmidt et al. (2009) emphasized that educational content must provide rich linguistic input crucial for vocabulary learning, a requirement fulfilled through the digital image media's concrete visual representations paired with meaningful project contexts in this study.

The qualitative transformations observed extend beyond mere score increases to encompass enhanced participation, motivation, and communication confidence among students. Digital image media proved effective in helping students construct word-meaning associations through enjoyable visual experiences, while the PBL model fostered active involvement through collaborative and contextual activities aligned with children's real-world experiences. These multidimensional improvements address the concerns raised by Rice and Hoffman (2015) regarding widening vocabulary gaps over time, suggesting that early, intensive, multimodal intervention can alter these trajectories. McKean et al. (2017) and Clegg et al. (2005) documented long-term consequences of untreated language disorders; the present findings offer promising evidence that targeted interventions during elementary years may mitigate these adverse outcomes by establishing stronger linguistic foundations during critical developmental periods.

In conclusion, the integration of digital image media within a PBL framework represents an effective and sustainable approach to enhancing vocabulary abilities among students with speech disorders. The intervention achieved progressive, sustained, and equitable improvements, supporting the critical importance of employing contextual, technology-enhanced, and project-based instructional media as innovative alternatives within inclusive education and holistic child language development initiatives. These results contribute empirical evidence to the theoretical frameworks proposed by Paivio (2007), Krajcik and Blumenfeld (2006), and contemporary researchers, while addressing practical instructional challenges identified by Steele and Mills (2011) and Norbury et al. (2016) regarding evidence-based vocabulary interventions for children with developmental language needs.

CONCLUSION

This classroom action research demonstrates that digital image media based on Project-Based Learning effectively enhances vocabulary abilities among third-grade students with speech disorders. The intervention achieved a substantial 33.37% improvement from baseline (48.94%) to post-intervention (82.31%) mean scores across three cycles, with 75% of participants advancing to the Developing Very Well category. These quantitative gains were accompanied by qualitative improvements in student participation, confidence, and active vocabulary usage, confirming that multimodal approaches combining visual technology with constructivist pedagogy address the complex needs of children with communication challenges.

This study contributes empirical evidence supporting dual coding theory and project-based learning frameworks within inclusive elementary education contexts, particularly for underserved populations with speech disorders. The findings demonstrate that contextualized, visually enhanced instruction can narrow vocabulary gaps that typically widen over time in children with language impairments. Practically, this research provides teachers with validated strategies for designing innovative, technology-integrated interventions while offering schools evidence-based frameworks for developing inclusive instructional media supporting diverse learner needs.

However, several limitations warrant acknowledgment. The small sample size (n=4) and single-site implementation limit generalizability across broader populations and educational settings. The three-month intervention period, while sufficient to demonstrate effectiveness, may not capture long-

term retention and transfer effects. Additionally, the study focused exclusively on vocabulary development without examining potential impacts on broader language domains or social-emotional outcomes.

Future research should replicate this intervention with larger, more diverse samples across multiple schools and cultural contexts. Longitudinal studies examining sustained effects beyond the intervention period would strengthen understanding of long-term efficacy. Investigations incorporating more interactive digital technologies such as augmented reality, mobile applications, or artificial intelligence-enhanced learning tools could further optimize outcomes. Finally, research examining non-cognitive factors including motivation, self-efficacy, and peer relationships would provide more comprehensive understanding of how multimodal interventions support holistic development in children with communication disorders.

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