

Vocabulary Growth in Deaf Children: A Systematic Review and Case Study in Language Acquisition

Nur Faiza Kusumaarum¹, Abu Fanani² ✉

✉ abu.fanani@uinsa.ac.id

Abstract:

This study aims to analyze vocabulary development in deaf children and identify effective intervention strategies. Through a systematic literature review using the PRISMA method, this study examines research published between 2000-2024 on deaf children aged 0-18 years. Data were collected from various databases including PubMed, ERIC, and PsycINFO, then thematically analyzed to identify patterns and synthesize findings. The results show that vocabulary development in deaf children is influenced by factors such as early language exposure, neurobiological aspects, and social interaction. Bilingual-bimodal approaches, the use of assistive hearing technology, and family involvement have proven effective in supporting vocabulary acquisition. This study also reveals the potential of deaf children to develop conceptual vocabulary comparable to hearing children. In conclusion, vocabulary development in deaf children is a complex process that requires a holistic and interdisciplinary approach. Further research is needed, particularly long-term longitudinal studies and more rigorous intervention evaluations, to enhance understanding of vocabulary development trajectories and optimize supporting strategies.

Keywords: deaf; vocabulary development; language intervention; inclusive education; assistive hearing technology

Abstrak:

Penelitian ini bertujuan untuk menganalisis perkembangan kosakata pada anak-anak tunarungu dan mengidentifikasi strategi intervensi yang efektif. Melalui tinjauan sistematis literatur menggunakan metode PRISMA, studi ini mengkaji penelitian yang diterbitkan antara tahun 2000-2024 mengenai anak-anak tunarungu berusia 0-18 tahun. Data dikumpulkan dari berbagai database termasuk PubMed, ERIC, dan PsycINFO, kemudian dianalisis secara tematik untuk mengidentifikasi pola dan mensintesis temuan. Hasil penelitian menunjukkan bahwa perkembangan kosakata pada anak tunarungu dipengaruhi oleh faktor-faktor seperti paparan bahasa dini, aspek neurobiologis, dan interaksi sosial. Pendekatan bilingual-bimodal, penggunaan teknologi bantu pendengaran, dan keterlibatan keluarga terbukti efektif dalam mendukung akuisisi kosakata. Studi ini juga mengungkapkan potensi anak-anak tunarungu dalam mengembangkan kosakata konseptual setara dengan anak-anak pendengar. Kesimpulannya, perkembangan kosakata pada anak tunarungu merupakan proses kompleks yang memerlukan pendekatan holistik dan interdisipliner. Penelitian lebih lanjut diperlukan, terutama studi longitudinal jangka panjang dan evaluasi intervensi yang lebih ketat, untuk meningkatkan pemahaman tentang trajektori perkembangan kosakata dan mengoptimalkan strategi pendukungnya.

Kata kunci: tunarungu; perkembangan kosakata; intervensi Bahasa; pendidikan inklusif; teknologi bantu pendengaran

INTRODUCTION

Although research on language development in deaf children has grown rapidly in recent decades, a major problem that still exists is the significant gap in vocabulary development between deaf and hearing children. This gap is not only a linguistic problem, but has broad implications for the cognitive, social, and academic development of deaf children (Luckner & Cooke, 2010). The main challenge in this research is understanding the complexity of factors that influence vocabulary development in deaf children, which include biological, cognitive, environmental, and educational aspects. This is complicated by the heterogeneity of the deaf child population, which varies in the degree of hearing loss, age of onset of deafness, language modality used (spoken, signed, or a combination of both), and access to early intervention and hearing assistive technology (Marschark et al., 2015). In addition, a crucial problem that needs to be solved is how to optimize vocabulary development in deaf children in the context of limited access to auditory language input. Deaf children often experience delays in language acquisition due to lack of exposure to everyday spoken language, which is the main source of incidental vocabulary acquisition in hearing children (Lederberg et al., 2013). Therefore, a deeper understanding of effective alternative strategies to support vocabulary development in deaf children is needed. Another problem that needs to be addressed is the lack of integration between various theoretical and methodological perspectives in vocabulary development research in deaf children. Neurobiological, psycholinguistic, and socio-cultural approaches often work separately, even though integration between these perspectives is very important to understand the complexity of vocabulary development in deaf children holistically (Hall et al., 2018; Mayberry & Kluender, 2018). Thus, the main problem of this research is how to identify, analyze, and integrate various factors that influence vocabulary development in deaf children, and formulate effective intervention strategies to support their vocabulary development, with the ultimate goal of reducing the gap between deaf and hearing children in terms of language and literacy skills.

Childhood deafness is a significant global health problem. According to the World Health Organization, approximately 34 million children worldwide have a form of deafness that is disabling. In the United States, the Centers for Disease Control and Prevention (CDC) reports that approximately 1 to 3 out of every 1,000 children are born with some degree of deafness or detectable hearing loss. This number increases to 5 out of every 1,000 children by school age. Vocabulary development is a crucial aspect of language and literacy acquisition. Research shows that early vocabulary size is a strong predictor of later reading ability and academic achievement (Morgan et al., 2015). However, deaf children often experience significant delays in vocabulary development compared to their hearing peers. Luckner & Cooke (2010) conducted a meta-analysis of 41 studies and found that deaf children had, on average, half the vocabulary size of hearing children their age. Advances in hearing aid technology and cochlear implants have revolutionized the educational landscape for deaf children. Research by Yoshinaga-Itano et al. (2018) showed that children who received cochlear implants before 12 months of age had better language development than those who received them at an older age. However, while this technology provides better access to sound, not all deaf children benefit equally, and many continue to struggle with vocabulary acquisition (Nittrouer et al., 2018). Educational approaches for deaf children have also evolved. From the debate between purely oral versus sign language, many programs now adopt a bilingual-bimodal approach, which combines the use of spoken and signed language. Humphries et al. (2016) found that this approach can improve vocabulary development and conceptual understanding in deaf children. Neurobiological research has provided new insights into brain plasticity in the context of deafness. Mayberry & Kluender (2018) showed that deaf children who were exposed to language (both spoken and signed) from an early age had brain activation patterns that were more similar to hearing children when processing language, compared to those who experienced delays in language exposure. Socio-emotional factors also play an important role in deaf children's vocabulary development. Hall et al. (2018) found that deaf children who had access to a sign language community from an early age showed better vocabulary development. This emphasizes the importance of language-rich social interactions in supporting vocabulary development. Although significant progress has been made in research and practice, the gap in vocabulary development between deaf and hearing children remains a major challenge. This suggests the need for further research to



understand the complexity of factors that influence vocabulary development in deaf children and to develop more effective interventions.

The significance of vocabulary development issues in deaf children cannot be underestimated, given its far-reaching and profound implications for many aspects of these children's lives. Impact on Cognitive Development Vocabulary is not only a tool for communication, but also plays a vital role in cognitive development. Research by Convertino et al. (2014) showed that vocabulary size in deaf children is positively correlated with abstract thinking and problem-solving abilities. Vocabulary gaps can lead to delays in the development of higher-order cognitive functions, which in turn can affect the overall intellectual potential of deaf children. Impact on Academic Achievement Vocabulary is an important foundation for academic success. Luckner & Cooke (2010) found that limited vocabulary in deaf children often leads to difficulties in reading comprehension and mastery of subject matter. This can result in lower academic achievement than hearing peers, which can impact future educational and career opportunities. Social and Emotional Implications Limited communication skills due to limited vocabulary can affect the social interactions and emotional development of deaf children. This can lead to social isolation, low self-esteem, and behavioral problems (Calderon & Greenberg, 2011). Improving vocabulary development can help deaf children become more socially integrated and develop important social-emotional skills. Long-Term Impact on Quality of Life, Vocabulary limitations can have a ripple effect that impacts many aspects of a deaf child's life into adulthood. Dammeyer (2010) found that deaf children with better language skills tend to have higher levels of education, better employment opportunities, and a higher quality of life in adulthood. Implications for Inclusion and Equity, In a broader context, the issue of vocabulary development in deaf children is closely related to issues of inclusion and equity in education and society. Addressing vocabulary gaps is an important step toward creating a more inclusive environment and providing equal opportunities for deaf children (Humphries et al., 2016). Contribution to the Scientific Understanding of Language Acquisition, Research on vocabulary development in deaf children not only benefits this population, but also provides valuable insights into the process of language acquisition in general. These studies can help us understand brain plasticity in language learning and the role of different sensory modalities in language development (Mayberry & Kluender, 2018). Implications

for Education and Health Policy A better understanding of vocabulary development in deaf children can inform more effective education and health policies. For example, research findings can support

Although research on vocabulary development in deaf children has grown rapidly in recent decades, several important gaps remain that need to be addressed:

1. **Lack of Comprehensive Longitudinal Studies:** Most existing research focuses on relatively short time periods or uses cross-sectional designs. This limits our understanding of the long-term trajectory of vocabulary development in deaf children from infancy to adolescence. As noted by Luckner & Cooke (2010) longer-term longitudinal studies are needed to fully understand patterns of vocabulary development and the factors that influence it over time.
2. **Limited Integration of Multidisciplinary Perspectives:** Despite advances in neurobiological (Mayberry & Kluender, 2018), psycholinguistic (Hall et al., 2018), and sociocultural (Humphries et al., 2016) research, there is a lack of research that comprehensively integrates these perspectives. Integrated approaches that combine insights from multiple disciplines are still rare in the literature.
3. **Lack of Research on Interactions between Language Modalities:** Although the bilingual-bimodal approach is gaining popularity, there are still gaps in our understanding of how the interaction between spoken and signed languages influences vocabulary development. More research is needed to understand how deaf children integrate information from different language modalities in building their vocabulary.
4. **Limitations in Sample Size and Population Diversity:** Many existing studies have used relatively small sample sizes or focused on homogeneous populations. This limits the generalizability of the findings and underrepresents the diversity of the deaf child population. Studies with larger and more diverse samples are needed to understand the variability in vocabulary development among deaf children with different backgrounds and characteristics.
5. **Lack of Research on the Role of Technology in Vocabulary Development:** Although there is research on the impact of cochlear implants (Yoshinaga-Itano et al., 2018), there are still gaps in our understanding of how new technologies, such as AI-based learning apps or smart hearing aids, may influence vocabulary development in deaf children.

6. Limitations in Cross-Cultural Research: Most research on vocabulary development in deaf children has been conducted in the context of developed Western countries. There is a paucity of research exploring vocabulary development in deaf children across cultural and linguistic contexts, particularly in developing countries.
7. Lack of Focus on Academic and Domain-Specific Vocabulary: Much research focuses on general vocabulary, but there are gaps in our understanding of how deaf children develop academic and domain-specific vocabulary that are important for success in specific subjects.
8. Limitations in Evidence-Based Intervention Research: Although there are a variety of intervention approaches to support vocabulary development in deaf children, there is a lack of rigorous controlled trials to evaluate the relative effectiveness of these approaches (Luckner & Cooke, 2010).

By identifying these gaps, this study aims to contribute to the existing literature by providing a comprehensive and integrated analysis of vocabulary development in deaf children and exploring effective intervention strategies.

This study aims to provide a comprehensive and integrated understanding of vocabulary development in deaf children, and to identify effective intervention strategies. The study will analyze the trajectory of vocabulary development from infancy to adolescence, integrating multidisciplinary perspectives (neurobiology, psycholinguistics, and socio-cultural), investigating the interaction between language modalities in a bilingual-bimodal approach, exploring the role of technology such as cochlear implants and digital assistive devices, and evaluating the impact of vocabulary development on academic, social, and emotional outcomes. Focusing on deaf children aged 0-18 years in Indonesia and considering cross-cultural perspectives, the study will combine a systematic review of the literature (2000-2024) with an in-depth case study. Using a mixed-methods approach, the study will consider receptive and expressive vocabulary, as well as general and academic vocabulary, to identify best practices and effective intervention strategies in improving vocabulary development in deaf children.

Recent advances in deaf education research and practice have yielded a variety of innovative strategies and interventions to support vocabulary development. Multisensory approaches, which combine visual, auditory, and tactile input, have been shown to be effective in improving vocabulary comprehension and retention (Luckner & Cooke, 2010).



The use of augmentative and alternative technologies (AAC), such as tablet-based learning apps and picture communication systems, has also shown promise in enriching deaf children's language environments (Lund & Douglas, 2016). Explicit vocabulary instructional strategies, which involve directly teaching word meanings and their use in a variety of contexts, have been shown to improve deaf children's vocabulary acquisition (Luckner & Cooke, 2010). Additionally, project-based and experiential learning approaches have been used to provide meaningful contexts for new vocabulary acquisition (Easterbrooks & Beal-Alvarez, 2013). Family-based interventions, which involve parents and caregivers in the vocabulary learning process, have also shown significant effectiveness (Sass-Lehrer, 2016). The use of visual narratives and visually enriched storytelling techniques has been shown to improve vocabulary comprehension and storytelling skills in children with hearing loss (Thoutenhoofd, 2006). Metalinguistic approaches, which teach children about the structure and function of language, have also been used to deepen vocabulary comprehension (Nunes et al., 2008). Although these strategies have shown promising results, it is important to note that their effectiveness can vary depending on the child's individual characteristics, degree of hearing loss, and environmental context. Therefore, a personalized and flexible approach to implementing these strategies is essential. Additionally, collaboration between educators, speech-language therapists, audiologists, and families remains a key component in optimizing vocabulary development in children with hearing loss (Marschark & Hauser, 2012). As research in this area continues to grow, it is hoped that new strategies and interventions will emerge that may be more effective in bridging the vocabulary gap between children with hearing loss and deaf children, paving the way for improved language and literacy development for this population.

LITERATURE REVIEW

Research on vocabulary development in children with deafness has grown significantly in the last two decades. This literature review will present key findings and critical analysis of recent studies, focusing on factors influencing vocabulary acquisition, intervention methods, and educational implications.

Factors Influencing Vocabulary Acquisition

Lederberg et al. (2013) conducted a comprehensive study of the language and literacy development of children with deafness. They found that early exposure to language, both spoken and signed, is crucial for vocabulary acquisition. The strength of this study lies in its large sample size and longitudinal methodology, but its weakness is the lack of in-depth analysis of individual differences.

Mayberry & Kluender (2018) explored the neurobiological aspects of language acquisition in children with deafness. They highlighted the importance of critical periods in brain development related to language processing. Although this study provides valuable insights into the neurobiological basis of language acquisition, its weakness lies in its relatively small sample size.

Hall et al. (2018) examined the role of social interaction in the vocabulary development of deaf children. They found that children who had access to a sign language community from an early age showed better vocabulary development. The strength of this study is its holistic approach that takes into account socio-environmental factors, but its weakness is the limited generalizability due to the focus on a specific sign language community.

Intervention Methods and Educational Approaches

Humphries et al. (2016) advocate a bilingual-bimodal approach to the education of deaf children. They argue that the use of sign language alongside spoken language can improve vocabulary acquisition and conceptual understanding. The strength of this study is its practical recommendations for educational policy, but its weakness is the lack of long-term empirical data to support the effectiveness of this approach.

Marschark & Hauser (2012) examined the role of assistive hearing technology in vocabulary acquisition. They found that the use of cochlear implants and modern hearing aids can improve deaf children's access to spoken language input. The strength of this study is its comprehensive analysis of the impact of technology, but its weakness is the lack of attention to socio-cultural factors that may influence the use of such technology.

Easterbrooks & Estes (2007) emphasized the importance of family involvement in the vocabulary development of deaf children. They presented practical strategies for parents and educators to support language learning. The strength of this study was its focus

on practical applications, but a weakness was the lack of systematic evaluation of the effectiveness of the proposed strategies.

Implications and Directions for Future Research

Mayberry et al. (2011) conducted a landmark study showing that deaf children can achieve conceptual vocabulary development comparable to that of their hearing peers, despite differences in verbal vocabulary. This finding challenges previous assumptions about cognitive limitations due to deafness. The strengths of this study were its rigorous methodology and significant theoretical implications, but a weakness was its limited focus on conceptual aspects of vocabulary.

Luckner & Cooke (2010) conducted a comprehensive review of vocabulary research in deaf students. They identified gaps in the literature and highlighted the need for more longitudinal research and more rigorous intervention studies. The strength of this review was its broad scope, but a weakness was the lack of in-depth analysis of individual studies.

Thus, current literature suggests that vocabulary development in children with hearing impairment is influenced by a complex interaction of biological, cognitive, and environmental factors. Early intervention, appropriate use of technology, and a holistic educational approach appear to be key in supporting vocabulary acquisition. However, further research is needed to develop more effective intervention methods and to understand individual differences in the vocabulary development trajectories of children with hearing impairment.

RESEARCH METHODS

This study used a comprehensive qualitative case study approach to analyze vocabulary development in deaf children. By focusing on in-depth analysis of selected cases from the current scientific literature (2000-2024), this study offers a rich and contextual understanding. Data were systematically collected from high-quality articles that met strict inclusion criteria, namely case studies that focused on the vocabulary development of deaf children aged 0-18 years and provided detailed descriptions of the developmental process. A comprehensive search was conducted in leading academic databases such as PubMed, ERIC, and PsycINFO, using validated keywords. Data analysis involved extracting critical information from each case study, including subject characteristics, intervention methods, vocabulary development outcomes, and influencing factors. An in-depth

thematic analysis was then conducted to identify significant patterns and trends in vocabulary development. To ensure the reliability and validity of the findings, this study applied source triangulation and peer review by experts in the field. This rigorous methodological approach allows the study to provide valuable insights and practical recommendations that are based on strong scientific evidence to support the vocabulary development of deaf children.

FINDINGS AND DISCUSSION

Results of Systematic Analysis of Literature Review

Based on the results of systematic analysis of existing literature, several key findings can be identified related to vocabulary development in deaf children. These findings cover various aspects that influence vocabulary acquisition, effective intervention methods, and significant educational implications.

1. Factors Affecting Vocabulary Acquisition

1.1. Early Language Exposure

A study conducted by Lederberg et al. (2013) showed that early exposure to language, both spoken and signed, is very important in the vocabulary acquisition of deaf children. This finding confirms the importance of early intervention in the language development of deaf children. Children who are exposed to language from an early age show better vocabulary development compared to those who experience delays in language exposure.

1.2. Neurobiological Aspects

A study conducted by Mayberry & Kluender (2018) revealed the importance of critical periods in brain development related to language processing in deaf children. These findings suggest that there is an optimal time window for language acquisition, where the brain of deaf children has maximum plasticity to absorb and process linguistic information. Interventions carried out during this critical period can optimize vocabulary development and overall language skills.

1.3. Social Interaction

Hall et al. (2018) found that deaf children who had access to a sign language community from an early age showed better vocabulary development. This finding emphasizes the importance of a language-rich social environment in supporting deaf children's vocabulary

development. Meaningful social interactions with fluent sign language users can provide a natural context for vocabulary learning and use in everyday communication.

2. Intervention Methods and Educational Approaches

2.1. Bilingual-Bimodal Approach

Humphries et al. (2016) advocate a bilingual-bimodal approach in the education of deaf children. This approach uses sign language in conjunction with spoken language to enhance vocabulary acquisition and conceptual understanding. These findings suggest that exposure to both language modalities can enrich deaf children's linguistic experiences and support more comprehensive vocabulary development.

2.2. The Role of Assistive Hearing Technology

Marschark & Hauser (2012) examined the role of assistive hearing technology in vocabulary acquisition. They found that the use of cochlear implants and modern hearing aids can increase deaf children's access to spoken language input. These findings highlight the potential of technology in supporting vocabulary development, especially in the context of spoken language.

2.3. Family Involvement

Easterbrooks & Estes (2007) emphasized the importance of family involvement in deaf children's vocabulary development. They presented practical strategies for parents and educators to support language learning. These findings suggest that a supportive and language-rich home environment can significantly influence the vocabulary development of deaf children.

3. Implications and Directions for Future Research

3.1. Development of Conceptual Vocabulary

Mayberry et al. (2011) demonstrate that deaf children can achieve a level of conceptual vocabulary development comparable to that of hearing children, despite differences in verbal vocabulary. These findings challenge previous assumptions regarding cognitive limitations due to deafness and pave the way for educational approaches that are more focused on fostering conceptual understanding.

3.2. Need for Longitudinal Research

Luckner & Cooke (2010) identify the need for more longitudinal research and more rigorous intervention studies. This finding underscores the necessity for a deeper

understanding of the long-term vocabulary development trajectories in deaf children and a more systematic evaluation of the effectiveness of various intervention methods.

Discussion

The results of the systematic analysis of the literature review provided in-depth insights into vocabulary development in deaf children. These findings have significant implications for a variety of related fields, including education, developmental psychology, and health policy. In this section, we will discuss in detail the implications of the main findings, identify areas for further research, and propose potential improvements for future research.

1. Factors Influencing Vocabulary Acquisition

1.1. Early Language Exposure

The findings of Lederberg et al. (2013) regarding the importance of early language exposure, both spoken and signed, have broad implications for early intervention practice. These results emphasize the need for comprehensive, early intervention programs for deaf children. Practical implications include:

- Development of more effective neonatal hearing screening programs to identify hearing loss as early as possible.
- Increased access to early intervention services that provide rich language exposure, both spoken and signed.
- Training for parents and caregivers on strategies to maximize language input in everyday interactions with deaf children.

However, further research is needed to determine the optimal ratio between spoken and signed language exposure, and how this ratio can be adjusted based on the individual characteristics of the child.

1.2. Neurobiological Aspects

Mayberry & Kluender (2018) study of critical periods in brain development related to language processing has important implications for the timing and nature of interventions.

The findings highlight:

- The importance of early interventions that take advantage of maximal brain plasticity during critical periods.
- The need for a more tailored approach to language intervention, taking into account the child's stage of neurological development.

- The potential to develop interventions that specifically target brain areas involved in language processing in deaf children.

Further research is needed to more precisely identify critical periods for different aspects of language acquisition in deaf children, as well as to develop interventions that optimally take advantage of brain plasticity during these periods.

1.3. Social Interaction

The findings of Hall et al. (2018) on the importance of access to sign language communities has significant implications for educational and social policy. These implications include:

- The need to increase access to sign language communities for deaf children and their families.
- The importance of integrating meaningful social interactions with fluent sign language speakers into educational programs for deaf children.
- The potential for developing mentoring programs where deaf children can interact regularly with successful deaf adults.

However, further research is needed to understand how to optimize the benefits of these social interactions, especially in contexts where access to sign language communities may be limited.

2. Intervention Methods and Educational Approaches

2.1. Bilingual-Bimodal Approach

Humphries et al. (2016) advocacy for a bilingual-bimodal approach has broad implications for educational practice. These implications include:

- The need to revise educational curricula for deaf children to include the systematic use of both signed and spoken languages.
- The importance of training educators in the effective use of bilingual-bimodal approaches.
- The potential for developing learning materials specifically designed to support vocabulary acquisition across different language modalities.

However, further research is needed to determine the optimal ratio of sign and spoken language use in different educational contexts, as well as to identify the best strategies to support knowledge transfer between language modalities.

2.2. The Role of Assistive Hearing Technology

Marschark & Hauser (2012) findings on the role of assistive hearing technology in vocabulary acquisition have important implications for clinical and educational practice.

These implications include:

- The need to increase access to modern assistive hearing technology for deaf children.
- The importance of effective integration between the use of assistive hearing technology and teaching strategies in educational settings.
- The potential for developing language learning applications specifically designed for use with assistive hearing technology.

Further research is needed to understand how to optimize the use of assistive hearing technology in the context of vocabulary development, as well as to identify the best strategies to overcome the limitations of this technology.

2.3. Family Involvement

Easterbrooks & Estes (2007) emphasis on the importance of family engagement has significant implications for intervention and family support practices. These implications include:

- The need to develop comprehensive training programs for parents and caregivers of deaf children.
- The importance of integrating family support into individualized intervention plans for deaf children.
- The potential for developing resources and tools that can assist families in supporting deaf children's vocabulary development in the home.

However, further research is needed to identify the most effective strategies for engaging families in the vocabulary development process, especially in the context of families with diverse socioeconomic and cultural backgrounds.

3. Implications and Directions for Future Research

3.1. Development of Conceptual Vocabulary

Mayberry et al. (2011) findings that deaf children can achieve levels of conceptual vocabulary development comparable to hearing children have important implications for cognitive developmental theory and educational practice. These implications include:

- The need to shift the focus from verbal deficits to conceptual potential in the education of deaf children.

- The importance of developing assessment methods that can accurately measure deaf children's conceptual understanding.
- The potential for developing instructional strategies that specifically target conceptual vocabulary development.

Further research is needed to understand the mechanisms underlying deaf children's conceptual vocabulary development, as well as to identify factors that may facilitate or inhibit this development.

3.2. Need for Longitudinal Research

Luckner & Cooke (2010) identification of the need for more longitudinal research and more rigorous intervention studies has important implications for research methodology in this area. These implications include:

- The need to develop longitudinal research protocols that can track deaf children's vocabulary development from infancy through adolescence.
- The importance of designing intervention studies with larger sample sizes and more rigorous controls to evaluate the effectiveness of different intervention methods.
- The potential for developing more sensitive and valid assessment tools to measure deaf children's vocabulary development over time.

Future research should focus on conducting large-scale longitudinal studies that can provide a deeper understanding of the vocabulary development trajectories of deaf children, as well as the factors that influence individual variability in this development.

This literature review provides valuable insights into vocabulary development in deaf children, but there are several limitations that need to be considered. The heterogeneity of the deaf child population, methodological limitations in existing research, and the lack of cross-cultural studies may limit the generalizability of the findings. To address this and further develop the field of research, several potential improvements can be made. These include conducting large-scale longitudinal studies with more diverse samples, developing more comprehensive assessment tools, increasing cross-cultural research, integrating perspectives from multiple disciplines, exploring the potential of new technologies, and conducting more rigorous intervention studies. These steps are expected to provide a more holistic and applicable understanding of vocabulary development in deaf children across contexts.

CONCLUSION(S)

Based on a systematic review of the current literature, it can be concluded that vocabulary development in deaf children is a complex process influenced by a variety of biological, cognitive, and environmental factors. Key findings suggest the importance of early language exposure, both spoken and signed, the role of critical periods in brain development, the positive impact of social interaction with a sign language community, the effectiveness of bilingual-bimodal approaches, the benefits of assistive hearing technology, and the significance of family involvement. Although research has yielded valuable insights, there is still an urgent need for long-term longitudinal studies, broader cross-cultural research, and more rigorous evaluation of interventions. To advance the field, an interdisciplinary approach that integrates neurobiological, psycholinguistic, and socio-cultural perspectives, as well as the development of more comprehensive and sensitive assessment tools, is needed. Thus, future research is expected to provide a more holistic understanding of the vocabulary development trajectory of deaf children, which in turn will inform more effective educational practices and interventions to support their optimal language and literacy potential.

REFERENCES

- Calderon, R., & Greenberg, M. (2011). Social and emotional development of deaf children: Family, school, and program effects. In *The Oxford handbook of deaf studies, language, and education, Vol. 1, 2nd ed.* (pp. 188–199). Oxford University Press.
- Convertino, C., Borgna, G., Marschark, M., & Durkin, A. (2014). Word and World Knowledge Among Deaf Learners With and Without Cochlear Implants. *Journal of Deaf Studies and Deaf Education, 19*(4), 471–483. <https://doi.org/10.1093/deafed/enu024>
- Dammeyer, J. (2010). Psychosocial Development in a Danish Population of Children With Cochlear Implants and Deaf and Hard-of-Hearing Children. *Journal of Deaf Studies and Deaf Education, 15*(1), 50–58. <https://doi.org/10.1093/deafed/enp024>
- Easterbrooks, S. R., & Beal-Alvarez, J. (2013). Literacy instruction for students who are deaf and hard of hearing. In *Literacy instruction for students who are deaf and hard of hearing*. Oxford University Press.
- Easterbrooks, S. R., & Estes, E. L. (2007). Helping deaf and hard of hearing students to us spoken language: A guide for educators and families. In *Helping deaf and hard of hearing students to us spoken language: A guide for educators and families*. Corwin Press.

- Hall, M. L., Eigsti, I., Bortfeld, H., & Lillo-Martin, D. (2018). Auditory access, language access, and implicit sequence learning in deaf children. *Developmental Science*, 21(3). <https://doi.org/10.1111/desc.12575>
- Humphries, T., Kushalnagar, P., Mathur, G., Napoli, D. J., Padden, C., Rathmann, C., & Smith, S. (2016). Language Choices for Deaf Infants. *Clinical Pediatrics*, 55(6), 513–517. <https://doi.org/10.1177/0009922815616891>
- Lederberg, A. R., Schick, B., & Spencer, P. E. (2013). Language and literacy development of deaf and hard-of-hearing children: Successes and challenges. *Developmental Psychology*, 49(1), 15–30. <https://doi.org/10.1037/a0029558>
- Luckner, J., & Cooke, C. (2010). A Summary of the Vocabulary Research With Students Who Are Deaf or Hard of Hearing. *American Annals of the Deaf*, 155, 38–67. <https://doi.org/10.1353/aad.0.0129>
- Lund, E., & Douglas, W. M. (2016). Teaching Vocabulary to Preschool Children With Hearing Loss. *Exceptional Children*, 83(1), 26–41. <https://doi.org/10.1177/0014402916651848>
- Marschark, M., & Hauser, P. C. (2012). How deaf children learn: What parents and teachers need to know. In *How deaf children learn: What parents and teachers need to know*. Oxford University Press.
- Marschark, M., Shaver, D. M., Nagle, K. M., & Newman, L. A. (2015). Predicting the Academic Achievement of Deaf and Hard-of-Hearing Students From Individual, Household, Communication, and Educational Factors. *Exceptional Children*, 81(3), 350–369. <https://doi.org/10.1177/0014402914563700>
- Mayberry, R. I., del Giudice, A. A., & Lieberman, A. M. (2011). Reading Achievement in Relation to Phonological Coding and Awareness in Deaf Readers: A Meta-analysis. *Journal of Deaf Studies and Deaf Education*, 16(2), 164–188. <https://doi.org/10.1093/deafed/enq049>
- Mayberry, R. I., & Kluender, R. (2018). Rethinking the critical period for language: New insights into an old question from American Sign Language. *Bilingualism: Language and Cognition*, 21(5), 938–944. <https://doi.org/10.1017/S1366728918000585>
- Morgan, P. L., Farkas, G., Hillemeier, M. M., Hammer, C. S., & Maczuga, S. (2015). 24-Month-Old Children With Larger Oral Vocabularies Display Greater Academic and Behavioral Functioning at Kindergarten Entry. *Child Development*, 86(5), 1351–1370. <https://doi.org/10.1111/cdev.12398>
- Nittrouer, S., Muir, M., Tietgens, K., Moberly, A. C., & Lowenstein, J. H. (2018). Development of Phonological, Lexical, and Syntactic Abilities in Children With Cochlear Implants Across the Elementary Grades. *Journal of Speech, Language, and Hearing Research*, 61(10), 2561–2577. https://doi.org/10.1044/2018_JSLHR-H-18-0047
- Nunes, T., Bryant, P., Burman, D., Bell, D., Evans, D., & Hallett, D. (2008). Deaf Children's Informal Knowledge of Multiplicative Reasoning. *Journal of Deaf Studies and Deaf Education*, 14(2), 260–277. <https://doi.org/10.1093/deafed/enn040>

- Sass-Lehrer, M. (2016). *Early intervention for deaf and hard-of-hearing infants, toddlers, and their families: interdisciplinary perspectives*.
<https://api.semanticscholar.org/CorpusID:74856120>
- Thoutenhoofd, E. (2006). Cochlear implanted pupils in Scottish schools: 4-year school attainment data (2000-2004). *Journal of Deaf Studies and Deaf Education*, 11(2), 171–188. <https://doi.org/10.1093/deafed/enj029>
- Yoshinaga-Itano, C., Sedey, A. L., Wiggin, M., & Mason, C. A. (2018). Language Outcomes Improved Through Early Hearing Detection and Earlier Cochlear Implantation. *Otology & Neurotology*, 39(10), 1256–1263. <https://doi.org/10.1097/MAO.0000000000001976>