

Critical Review:
Literacy Skill Development in Augmentative and Alternative Communication Users

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This evaluation reviewed published works to assess the current evidence of the factors that limit literacy and the effectiveness of structured intervention on literacy skill development in school-aged children who are augmentative and alternative communication users (AAC). Literacy skills, such as phonological awareness, vocabulary development, and letter-sound associations, are an important part of language development in children. AAC users may not be receiving proper educational tools to develop those literacy skills. Seven studies were reviewed to determine factors of literacy development. Further research in this area is needed.

Introduction

One of the greatest barriers to the understanding of literacy skill development in augmentative and alternative communication (AAC) users is the absence of evidence surrounding varied forms of literacy programs in educational settings for those who use AAC (Light, McNaughton, Weyer & Karg, 2008). Augmentative and Alternative communication is a communication method used for children to replace speech or writing that may be impaired. Research has shown that up to 90% of children with complex communication needs do not receive proper educational tools to develop literacy because it is unknown how to adapt educational programs to fit their needs. AAC users may be missing these learning opportunities due to educational settings that may not be equipped to provide resources and opportunities for these children to actively engage in their classroom because there is not enough understanding of how to use various AAC tools to benefit their learning. (Light & Mcnaughton, 2015). Literacy and language development are intertwined so to understand literacy processes it is necessary to identify the factors effecting literacy skill development taking into account the individual's changes in cognition, perceptual, physical, and sensory processes (Bailey, Angell & Stoner, 2011). Authors Balkom & Verhoeven (2010) identify the specific lexical processes important for literacy development, including orthographic representation of words, retrieval of spoken words, and phonological output of words as imperative to the development of vocabulary, experiential and general knowledge of words, and syntactic knowledge.

School aged AAC users face several barriers in educational setting to developing these literacy skills including not reading at higher levels, performing below their grade level, having limited educational

opportunities to enhance their reading and writing skills, the overall perception that they have less capabilities than their peers, and being given less opportunities to try (Strum et al., 2010).

Researcher have sought to identify specific factors that prohibit AAC users from reaching their full literacy potential and make suggestions to adapt education processes known to develop language and literacy skills. These recommendation are to make literacy development more achievable for children with complex communication needs who use AAC devices and include school team members who are experts in the different technology tools that these children use (Sturm, Erickson & Yoder, 2010), enhancing the experiences of literacy with real-world situations and personal experiences (Hetzroni, 2004), and taking the pre-programmed devices and making them more personal to the vocabulary the individual child is familiar with (Wilkins & Ratajczak, 2009).

Objectives

The primary objective of this review is to determine current evidence identifying specific factors effecting literacy skill development specifically in AAC users, and intervention outcomes.

Methods

Search Strategy

Online databases such as Google Scholar and PubMed were used to find articles of interest. The initial search used keywords: (literacy development in AAC users), and were further refined using [(literacy development) AND (augmentative communication users)]. Using the acronym AAC and the full name allowed for more specific findings of study-based articles.

Selection Criteria

Papers were selected for review if they met the following inclusion criteria: articles published within the last 15 years and contained material regarding theories about AAC user's overall language development with discussion specifically about literacy skills. Five of the main articles were selected for analysis. A more narrowed search using the full name "Augmentative and Alternative Communication" as opposed to the acronym "AAC" found a single-case study design using a structured intervention by Bailey, Angell, & Stoner (2011), and a systematic review of previous studies with an example of a single-case study by Light, McNaughton, Weyer & Karg (2008).

Data Collection

In total 7 papers met the inclusion criteria. Three information-based papers (Sturm et al., 2010; Light and Mcnaughton, 2015; Wilkins & Ratajczak, 2009) analyzing strategies used to produce effective literacy development in AAC users, three systematic reviews, (Hetzroni, 2004,; Balkom & Verhoeven, 2010; Light et al 2008) and one single-case study design focusing on structured literacy interventions in AAC users (Bailey et al (2011).

Results

Sturm, Erickson & Yoder (2010) is an informational paper discussed literacy development in an educational setting, recommendations for inclusion of AAC users in mainstream education through program modification and recommendations for future research. The authors did not cite experimental evidence but provided specific and functional evidence surrounding literacy development and how to better these skills for AAC users throughout their school years. General educational practices in the classroom, such as communication strategies, vocabulary development, participation, and reference to real-life situations were discussed to highlight specific areas that could be modified to suit an AAC users as they develop basic literacy skills. Four key recommendations were made to support AAC users' functionality in the classroom: ensure students are actively participating in all class discussions, choose specific AAC technology and systems that can be personalized for content, time tasks appropriately, and offer functional messages that the student can relate to their personal experiences. Four factors were identified to support literacy development and further education for individual AAC users: standardized literacy intervention approaches that can be taught by teachers and educational support workers, accessibility of technology, assessments that generate specific personal intervention strategies, and the development of structural interventions that develop literacy skills using

AAC tools. The authors conclude that providing educational opportunities for literacy skill development in AAC users is possible by modifying classroom culture and creating individualized program modifications that can function within their classroom contexts.

The authors provide suggestive evidence that there are multiple contextual factors interacting to effect literacy skill development in AAC users

Wilkins & Ratajczak (2009) in a position paper discussed high-tech AAC devices and their recommended use for the development of literacy skills. The authors identified sustained attention, identification, discrimination, and processing of specific information goals to determine the functionality of a device. Dynavox Series V AAC device and Vmax AAC devices were chosen for study because their ability to develop letter-sound associations, phonemic awareness, and decoding should support literacy skill development needed to reach these goals.

Two specific tasks on these devices were discussed to demonstrate the possibilities of skill development. 1. Development of word structure understanding through picture-word associations and 2. Enhancing comprehension with the development of sentences and stories using picture-word associations. Learning reading comprehension is scaffolded by seeing the word, hearing the word out loud, matching the word with a visual aid to enhance meaning, and putting the words together into small sentences. Communicating with a partner in these tasks is also possible expanding the meaningfulness of the exercise for the individual.

The authors end with an overall discussion of how these high-tech devices may be used to develop literacy skills through letter-sound correspondence, develop blending of sounds, develop an understanding of words, linking these words to visual pictures provided on the device, and connecting meaning to these skills.

This paper provides suggestive evidence that high level AAC technology can provide resources to develop specific skills once the factors effecting the individual's skill development has been identified.

Light & Mcnaughton (2015) was the third paper to utilize information about the topic to increase awareness and analyze the interventions that have already been developed. The authors focused on bringing to light the amount of AAC users who are affected by limited literacy development interventions in their school settings, specifically 90%, and the long-term effects this could possibly have when these children enter

adulthood. Their main population of interest was students with complex communication needs, which as addressed in other papers, is one of the most affected populations during literacy development.

The authors highlighted recommendations for interventions that should be used in educational settings when developing literacy skills. Some of these concepts included using structured interventions in order to build individual students skills and focus on their strengths in order to integrate those skills in their daily communication, combining these skills and strengths with real-life contexts, and also keeping in mind the individual psychosocial factors that may affect the individual's participation.

A specific model that the authors emphasized that could integrate the desired skills discussed above is the International Classification of Functioning, Disability and Health (ICF). This model builds upon two frameworks, with one being a social model of disability. This ties in with the authors focus on developing important skills in their education in order to use them in different environmental contexts, personal situations, and social relationships built over time.

The main prominence of the paper is to tie all personal factors into interventions for children who use AAC in order to increase their motivation and confidence in their learning.

Overall, this paper provides suggestive evidence for literacy development in AAC users, and how specific personal factors and environmental experiences of these users contribute to better outcomes of literacy skill development. Evidence also suggests that the specific intervention from the ICF model building on social experiences of AAC users can be integrated in educational learning in order to develop literacy skills.

Bailey et al (2011) utilized a single-subject multiple baseline structured intervention design following 4 participants, 2 boys and 2 girls aged 12.5-15 years of age, over 11 months following direct, scaffolded, instructional lessons with an emphasis on an error correction system, and phonemic and phonological awareness. The goal was to determine the effects of these literacy interventions on children with complex communication needs who use AAC systems. Although there was no specific statement of how these participants were obtained or why they were chosen, it was made known that three of the four children were diagnosed with Autism Spectrum Disorder and were all attending junior high school. The type of AAC (high or low-tech) was not focused on but instead the overall use of the system. Each child was paired with a registered

Speech-Language Pathologist (S-LP) and given 18 specific phonemes to develop by the end of the study period. The AAC program Boardmaker was used to create pictures to represent the 18 phonemes with various word possibilities. The study was divided into three sets focusing on six specific phonemes in each set, and data was collected before the beginning of each lesson, as well as every three weeks. During each set, two components were targeted: an interactive reading experience with all four participants using a picture-book that was focusing on the targeted sounds, then individual work between the S-LP and participant using a scaffolded method of increasing difficulty. These sessions occurred for 20 minutes, with a total of nine weeks of intervention, and pre-and post-tests completed at the beginning and end of the study in order to obtain baseline, intervention, and maintenance conditions.

The results exhibited two students who made progress in all three sets and maintained this success at a 5-month post-test follow up, where the other two students made progress in two of the three sets. One student did not make progress in the third set due to difficulty with visual differentiation of the individual phonemes, and the other student made no progress in the third set.

Overall, the study did find a relationship between the structured intervention and letter-sound correspondence, but unable to identify a relationship between decoding and identification of novel words. Some limitations expressed were background noise from the classroom since the structured intervention occurred in the room with other students, and visual discrimination of certain letters.

In conclusion, this paper provides compelling evidence that specific intervention tasks and structured activities focusing on specific phoneme development in the sound, letter, and word forms can support literacy development in AAC users.

Hetzroni (2004) examined literature that focused on literacy skill development in AAC users in order to better understand the process of the development of these skills. Hetzroni first discussed risks and limitations for AAC users when learning literacy. These barriers included a lack of participation in their classroom setting, limited vocabulary, and their own developmental barriers such as motor or sensory deficits. With limited access and participation, AAC users miss much information needed when learning, have less expectations by teachers than their peers, and lose the ability to interact with others to enhance their learning. With an understanding of these barriers that effect literacy development, the author focuses on specific adaptations that can be made for these children

in order to enhance their learning and provide more opportunities to grow. Some of these recommendations included the use of graphic symbols that help comprehend words and make connections between the symbol and the meaning of the word, similarly to when students are learning how to print words. Learning to print words is one of the fundamentals first focused on before literacy development occurs, and so if there is a shift of focus to graphemic symbols, this can compensate for those limited learning experiences and allow children to develop a greater vocabulary, enhancing their writing experiences, and overall enhance literacy skills.

In order to implement these tasks, it is imperative to understand the computer systems the child is using, and programming the system to learn and recognize orthographic symbols as opposed to pictures that are pre-programmed. Changing these settings allows the learner to develop that connection between symbols and words, and one specific way the author describes this is through the use of picture books, so that the child is able to manipulate the words being presented, learning their meaning, and manipulating them into their own personally-formed sentences. One way to further develop skills is through the use of a fading program, which occurs once the basic skills are developed, by learning specific logos that represent a written word, and slowly the logos disappear, requiring the child to match the word with the corresponding symbol left over and make the connections in processing the word.

Although this paper does not discuss any concrete findings that these interventions may benefit AAC users, the information is still suggestive in the evidence since it focuses on a specific task of programming AAC devices that can be used for a specific literacy skill. Understanding the variety of AAC devices a user may have and how to use specific programs for tasks being focused on in their classroom setting is imperative to understand in order to provide the best learning experiences.

Balkom and Verhoeven (2010) critically reviewed papers that focus on a neurocognitive perspective to literacy development in AAC users. The perspective emphasizes the lexical processing of words through orthographic representation and output and retrieval of spoken words from the phonological output lexicon. This process thus facilitates reading through experiential learning, making meaningful relationships between words, and understanding the underlying syntactic knowledge in how letters are strung together to form words.

The authors decided to look at learning strategies of reading and writing from a cross-linguistic perspective, mainly from articles published in English, Dutch, Swedish and German.

The first paper written by Van der Schuit, Segers, van Balkom, Stoep, and Verhoeven emphasize the importance of early literacy intervention in home and school settings. Their intervention analyzed early language development, emergent literacy, and overall communication in children with complex-communication needs in order to determine if there was a growth in vocabulary, which did occur due to a transactional approach focused on experiential learning, storybook reading, and environmental interactions.

The second paper by Dahlgren Sandberg, Smith, and Larsson did a study on Swedish and Irish children to understand their phonological awareness, reading, and spelling through a variety of tasks. Their main population was children with Cerebral Palsy, and found that teacher expectations, environmental factors, and instructional practices proved to be the greatest barriers to literacy development.

In the third paper by Erickson and Sachse, the focus was on reading acquisition through AAC technology in English and German children. Features of reading such as identification of parts of a word, and syllables and morphemes represented as symbols, are essential in the development of lexical processes for literacy development. Scaffolding strategies used to facilitate identification of the parts of words and comprehend meaning of words are important across all languages. The use of an AAC partner is also beneficial for the shared development of symbols, signs and words in order to combine them for meaning.

The fourth paper by Koppenhaver and Williams reviewed research that focuses on the development of writing. When learning to write, students develop internal representations of words and their meanings. Through this development the authors believe it is important to develop two processes of evaluating and revising before the written form of a word is needed in correspondence with situational and contextual experiences. No study by the authors was done but instead wished to create implications for future research to be done.

Overall, their critical review provides suggestive evidence of a paucity of understanding of the factors affecting literacy development in AAC users. Further research is needed.

Light, McNaughton, Weyer & Karg (2008) critically reviewed research that focused on literacy instruction that had been altered for AAC users, and utilized the information gathered to do their own case study. The areas of interest for these authors were reading and writing skills used to develop literacy. Before these skills are developed, the authors wanted to highlight the areas of language needed to develop literacy, such as phonological awareness through sound blending and phoneme segregation, letter-sound correspondence with a focus on vowel development first, decoding skills, and sight-word recognition by pairing symbols with words, which all work together to activate reading abilities.

After analyzing this information, the authors proposed using a known book to the AAC user to develop written skills through a hierarchy of modelling certain skills, scaffolding activities to complete a skill, and having the opportunity to independently use those skills.

From this information, a case example was done on an eight-year-old female student with multiple disabilities due to a rare genetic disorder that affected her speech, vision, motor, and hearing abilities. The participant was able to communicate using a specific system called Mercury, as well as gestures, facial expressions, and some vocalizations. After a baseline was obtained, the participant took part in one-on-one structured interventions for 30 minutes twice a week. Tasks were adapted to her needs, including using larger font for visual purposes, an FM system to help with comprehension, and a visual calendar for reference to keep up with the schedule. Materials were provided orally, in symbols, and traditional orthography to increase access to all literacy forms. During the initial phase of instruction, sight-word recognition, letter-sound correspondence, and single word decoding were worked on to help build vocabulary. A shared reading activity that utilized personal books from the participant were completed to integrate the specific skills worked on in isolation. This phase lasted seven months, and showed promising gains being made by the participant to become a good reader. A second phase took place from months 8-16, where the instructional tasks increased to meaningful reading and writing activities. At the end of this second and final phase, the participant had taken part in 16 months of individual instruction and 55 hours of work, and she was able to read over 60 words and had 90% accuracy using her assistive device to read simple sentences. One challenge that was noted was the generalization of results due to the abundance of rare communication needs that differ for almost every child.

Overall, this research provided compelling evidence that instruction that is adapted for the individual AAC user

allows the chance to develop the necessary language skills to become good readers and develop literacy skills. By integrating the system, the child has access to and uses that device in multiple domains of their learning provides enhanced opportunities to explore and experience these literacy skills in a way that is more personalized for their learning development.

Discussion

The purpose of this paper was to understand the development in literacy skills specifically in AAC users, the types of interventions that have been used, the limitations of this topic, and the recommendations for future research. Findings from information-based articles, single-case studies, and critical reviews exposed the multitude of barriers and limitations of literacy development in this population and the negative effects it can have long-term. These bodies of research provided both suggestive and compelling evidence surrounding literacy skill development in AAC users by focusing on specific factors that enhance these users learning experiences, and creating interventions that are specific to each individual's learning needs. Various authors concluded that this topic is in need of further research, but had proof to show that adaptations of language and literacy development are capable to shape the necessary skills not only for literacy but overall language and communication.

Findings from the information-based literature proved that the most important factors for the development of literacy include phonological awareness, decoding, letter-sound correspondence, word retrieval, and vocabulary development (Balkom & Verhoeven, 2010). Although this information emphasizes the important learning outcomes in developing literacy skills, it leaves open the discussion of which skills help with literacy development more in AAC users. Authors from each article also display common barriers to development of literacy in AAC users, specifically lack of educational support, minimal opportunities for participation, and minimal opportunities to make meaningful connection to personal social and environmental experiences (Sturm, Erickson & Yoder, 2010). Understanding these barriers are extremely important in understanding the changes that need to be made in order to allow the growth and development of literacy skills and allow for a more concrete starting point in literacy development. Authors Balkom & Verhoeven, 2010 went as far as to outline eight specific aspects of education that can be adapted for students who use AAC devices, which included direct interaction between students who use AAC and their peers, discourse structures and vocabulary development links between students and AAC users, using the specific AAC systems to target

effective communication among all class members, understanding the best AAC systems for the specific classroom topics, engaging relationships of educational topics to personal experiences, management strategies to support communication, any constraints that may come from an AAC system on participation, and specific instructional methods for literacy development. Outlining the main areas of weakness in education of literacy is helpful to understand what the limitations of this research are and how to better the future development of this topic. Another paper (Wilkins & Ratajczak, 2009) emphasized the personal factors of the student who uses an AAC system and understand how they process information, identify and discriminate between sounds and words will come into play when developing information, and so it is of importance to take into account these personal factors in future research and provide a good beginning to changes in how literacy teaching can be modified and implemented for AAC users.

The two works that did focus on single-case studies both emphasized the importance of individual one-on-one interventions for children in order to provide more personalized tools to enhance literacy development on generalized skills that all children need, and thus were able to prove that with time and resources children who are AAC users are able to develop these skills just as their peers can but at their own pace and with their own experiences (Bailey, Angell & Stoner, 2011; Light, McNaughton, Weyer & Karg, 2008). This work is proof that literacy development is possible for AAC users and provides real examples of specific interventions that work for AAC users.

The remaining works emphasized critical analyses of others work and used the findings to make their own clinical recommendations for future works and studies. Hetzroni (2004) focused research on graphic symbols to enhance writing experience using AAC programs that can be made to personally fit each individual user in a way that is adapted from the writing experiences of other classmates. Focusing on something more specific and analyzing the work that has previously been done allows for a closing in the literature gap about specific interventions that can be adapted for AAC users. Authors Light and McNaughton (2015) emphasized the findings from their empirical research on environmental factors that come into play on literacy development, as well as personal and psychosocial factors that are very important to take into account when creating intervention strategies in order to build on their strengths and social contexts to further their development just as their peers do in their everyday learning.

Unfortunately, most of the research was mainly focusing on barriers to literacy development and recommendations for future research and interventions, but more needs to be done with specific studies on intervention strategies and long-term outcomes of literacy development of AAC users. There was some discussion among the literature about the common AAC systems and programs used by students, and so this is also a very important topic that needs more research to understand how these programs work and how to find which programs work best for different users.

Conclusion

Overall, this evidence-based project was the focus on the development of literacy skills in children who are users of augmentative and alternative communication devices. Although the topic was difficult to gain evidence to support the belief that there are factors to be identified that shape these learning experiences and ways to manage how these factors interact, research is being developed on these ideas and those researchers are encouraging others to do the same.

Clinical Implications

The findings from these papers were able to answer the question of what factors are important when developing literacy skills in AAC users and types of interventions that may be used by understanding that these individual characteristics of each learner are viewed as barriers to literacy skill development. By identifying these barriers, it can be concluded that each child is different, and by looking at the factors that contribute to literacy learning, understanding the types of devices that may be used by learners, and the experiences in life that utilize literacy skill development can shape individualized program creations for these AAC users. It is also important to understand others who are involved in an AAC users overall learning experiences, such as teachers, parents, special education assistants, or other professionals, and using those experiences throughout a child's day integrated in with their literacy skill development.

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