Evidence-Based Literacy Instruction for Individuals Who Require Augmentative and Alternative Communication: A Case Study of a Student with Multiple Disabilities

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ABSTRACT

Literacy skills provide numerous benefits to individuals who require augmentative and alternative communication (AAC), including new opportunities for education, work, and social interaction. Literacy skills also have a powerful impact on communication and language development. This paper describes the components of effective evidence-based literacy instruction, including skills to target for instruction, effective instructional procedures to teach these skills, and adaptations to accommodate the needs of individuals with significant speech, motor, and other disabilities. The paper also presents a case study that describes ongoing intervention with an 8-year-old girl with multiple disabilities who required AAC. Evidence-based instruction was provided in phonologic awareness, letter-sound correspondences, decoding, sight-word recognition, reading connected text, reading comprehension skills, and early writing and keyboarding skills. During the 16 months of intervention, a total of 55 hours of instruction, the student acquired 20 letter-sound correspondences, learned to use decoding and sight-word skills to read 60 words, and began to read simple texts both in shared reading activities and independently. She also began to type simple short messages and stories using spelling approximations. The acquisition of these new literacy skills resulted in increased educational opportunities for the learner and also enhanced her language and communication skills.

KEYWORDS: Augmentative and alternative communication, literacy, reading, writing

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Learning Outcomes: As a result of this activity, the reader will be able to (1) describe essential components of literacy instruction for individuals who require augmentative and alternative communication (AAC), (2) describe the importance and function of the three steps included in *direct explicit instruction* of basic skills, and (3) describe appropriate adaptations to support participation for individuals who require AAC in literacy instruction activities.

It is difficult to overestimate the importance of literacy skills for individuals with complex communication needs who require augmentative and alternative communication (AAC). Learning to read and write (a) enhances cognitive development and advances learning; (b) facilitates participation in the educational curriculum; (c) provides access to a greater range of employment opportunities; (d) facilitates the use of mainstream technologies; (e) supports the development of friendships and social relationships (e.g., through e-mail, instant messaging, social networking Web sites); (f) fosters personal expression (e.g., through journals, autobiographical writing, personal Web sites); (g) enhances personal organization (e.g., through schedules, lists); and (h) provides access to meaningful and enjoyable leisure pursuits (e.g., reading books for pleasure).[1,2] In fact, literacy skills have assumed even greater importance in recent years with society's increased reliance on text-based technologies such as the Internet, computers, and cell phones.[3]

The importance of literacy skills for individuals who require AAC extends well beyond the benefits described above. The acquisition of literacy skills also offers the potential to significantly improve communication and enhance language development. Without literacy skills, individuals who require AAC must rely on others to provide them with access to appropriate vocabulary/symbols to communicate. With the acquisition of literacy skills, individuals who require AAC can communicate any message to any individual.[4] They have complete access to the generative capacity of language. Thus, the acquisition of literacy skills offers individuals who require AAC tremendous advantages for communication and language development in addition to substantial educational, vocational, social, and personal benefits.

Unfortunately, many individuals who require AAC do not acquire functional reading and writing skills.[5–7] One of the major barriers to the acquisition of literacy skills with this population has been the lack of effective evidence-based instruction adapted to meet the needs of individuals who require AAC.[8,9] There is an urgent need to develop, implement, and evaluate literacy instruction designed to meet the complex needs of individuals who require AAC to ensure their successful acquisition of literacy skills.

The goals of this paper are as follows: (a) to review the research and describe the essential components of literacy instruction for this population and (b) to provide a case example to illustrate implementation of evidence-based literacy instruction with a student with multiple disabilities who required AAC. This paper focuses only on the early stages of instruction in conventional literacy skills (i.e., learning to read and write). Discussion of the development of advanced literacy skills (i.e., reading and writing to learn) is beyond the scope of this paper; readers are referred to Light and McNaughton for further discussion of intervention to build advanced literacy skills with individuals who require AAC.[10] It is also beyond the scope of this paper to discuss the development of emergent literacy skills prior to instruction in conventional literacy.

LITERACY INSTRUCTION FOR INDIVIDUALS WHO REQUIRE AAC

This section describes the components of effective evidence-based literacy instruction based on the results of a 5-year research grant funded by the National Institute on Disability and Rehabilitation Research as part of the Rehabilitation Engineering Center on Communication Enhancement (the AAC-RERC II).[2] The instructional program is based on the recommendations of the National Reading Panel[11] and provides adaptations to support the participation of individuals who require AAC. The program builds on earlier literacy research

with individuals who require AAC.[12,13] This section describes the following components of literacy instruction: (a) the skills targeted for instruction; (b) the techniques used to teach these skills; and (c) the adaptations to allow full participation by individuals who require AAC.

Skills Targeted for Instruction

The acquisition of conventional literacy skills is a complex process that rests on the integration of knowledge and skills in a variety of interrelated domains, including language skills, phonologic awareness skills, knowledge of letter-sound correspondences, decoding skills, sight-word recognition skills, application of decoding and sight-word recognition skills during meaningful reading activities, reading comprehension skills, early writing skills, and text production/keyboarding skills.[14]

LANGUAGE SKILLS

To read and understand texts and to compose meaningful written texts, individuals who use AAC require semantic, syntactic, and morphologic skills, as well as knowledge of different written genres (e.g., narrative, persuasive).[4] Individuals who require AAC frequently require concerted language intervention to promote pragmatic, semantic, syntactic, and morphologic development and to lay the foundation for literacy learning.[15] Although language skills greatly facilitate literacy learning, they should not be viewed as a prerequisite to literacy instruction. In fact, our research suggests that literacy instruction can serve to bootstrap language development for individuals who require AAC, especially syntactic and morphologic development.[2]

PHONOLOGIC AWARENESS SKILLS

Individuals who require AAC also need to develop phonologic awareness skills to support the acquisition of conventional literacy skills.[14,16] Phonologic awareness is defined as an individual's understanding or awareness of the sound structure of language; it involves the ability to notice, think about, and manipulate the phonemes of words.[17] Research suggests that individuals who require AAC can develop phonologic awareness skills despite severe

speech impairments; however, many demonstrate deficits in phonologic awareness compared with that of their nondisabled peers.[18–24] Focused instruction is typically required to build phonologic awareness skills with individuals who require AAC. In our instructional program,[2] we focus primarily on teaching sound blending and phoneme segmentation skills because these phonologic awareness skills are strongly correlated with later positive literacy outcomes.[25]

Sound blending skills involve the ability to build words from individual phonemes; these skills are essential to the process of decoding novel words.[26] Typically, sound blending tasks require students to listen to a word said slowly (with the individual phonemes in the word each extended 1 to 2 seconds) and then blend the sounds and say the word orally at a typical rate.[11] This task can be adapted to allow individuals who require AAC to respond by selecting the AAC symbol representing the target word from an array of symbols provided by indicating the AAC symbol from their own aided AAC system (e.g., communication board or speech-generating device [SGD]) or by signing.[12,27,28]

Phoneme segmentation skills refer to the ability to break words down into individual sounds; these skills are essential to the writing process.[29] Usually, instruction focuses on segmentation of the initial sounds of one-syllable words because these tend to be stressed and are easier to learn to segment.[13,24] Instructional tasks typically require students to listen to a word and then say the beginning sound. The task can be adapted as follows for individuals who require AAC: The learner is presented with a sound orally and then indicates the word that starts with this sound by selecting the correct AAC symbol from an array of symbols, by using their own aided AAC system, or by signing.[12,30]

KNOWLEDGE OF LETTER-SOUND CORRESPONDENCES

To learn to read and write, students must understand the correspondence between the phonemes, or sounds of speech, and the graphemes, or letters of the written language, that encode speech.[14] Instruction in letter-sound

correspondences can be easily adapted for individuals who require AAC to bypass the need for oral responses: Learners are presented with a sound orally and asked to indicate the letter that represents the sound from an array of letters provided or from a keyboard adapted to meet their needs.[2,12,13,28,31] Carnine et al suggest letter-sound correspondences should be introduced incrementally, with the following considerations: (a) the most frequently used letter-sounds should be taught first; (b) short vowels should be taught before long vowels; (c) letter-sound correspondences that are similar visually or aurally should be separated within the instructional sequence to minimize confusion; and (d) lowercase letters should be taught prior to uppercase letters because the former occur more frequently in written texts.[32]

DECODING SKILLS

Decoding skills involve the integration of knowledge of letter-sound correspondences and sound blending skills as well as language skills.[33] Students must be able to (a) look at a written word; (b) recognize each of the letters in the word and retrieve its sound in sequence; (c) blend the sounds together to form the word; and then (d) retrieve the meaning of the word. Typically, decoding tasks require students to sound a word out and then say the word orally. Fallon and colleagues proposed the following adaptation to bypass the need for oral responses: The student who requires AAC is presented with a written word and must indicate the AAC symbol that represents the written word from an array of AAC symbols, representing four different words, including (a) the target word, (b) a word that differs only in the initial letter-sound, (c) one that differs in the medial letter-sound, and (d) one that differs in the final letter-sound.[12] Analysis of the AAC symbols selected by the student in error allows the instructor to determine patterns that may indicate areas of difficulty that require further instruction (e.g., most errors reflect difficulty with medial vowels).

SIGHT-WORD RECOGNITION SKILLS

Unfortunately, not all words in the English language are regular and easily decoded; therefore, individuals who require AAC must also develop sight-word recognition skills to read irregular words that are difficult to decode. In addition, individuals who require AAC may also be taught to recognize by sight more complex, high-interest words (e.g., dinosaur names, names of popular characters) to enhance their motivation for reading.[2] Typically, sight-word instruction involves some type of paired associate task where the written word is paired with the spoken word, sign, or AAC symbol.[8] Although it is essential for individuals who require AAC to learn to recognize irregular words by sight, literacy instruction should not be limited to teaching isolated sight-word vocabulary because students with AAC needs will be severely restricted in their ability to read a wide range of words and texts successfully.[8]

APPLICATION OF DECODING AND SIGHT-WORD RECOGNITION SKILLS IN READING ACTIVITIES

As soon as individuals who require AAC learn some basic decoding skills and/or recognize a few sight words, they should have numerous opportunities to apply these skills in the context of meaningful shared reading activities. In these activities, the literate partner (e.g., teacher, educational assistant, parent, peer reading partner) reads the text of the book and pauses for the individual who requires AAC to read specific words. The individual who requires AAC reads the target word and then indicates the word by selecting the AAC symbol on a communication board or SGD or by signing.

A wide range of reading materials can be easily adapted for shared reading activities including *I Spy* books, children's books, books related to curriculum content, or personalized stories of the learner's experiences.[2,12] Shared reading activities provide important opportunities for learners to apply their basic skills in the context of meaningful and enjoyable reading experiences. As individuals who require AAC acquire greater competence and fluency decoding and recognizing words by sight, they can assume responsibility for reading an increased number of words per page until they make the transition to reading simple stories.[2]

BUILDING READING COMPREHENSION SKILLS

The ultimate goal of literacy instruction is for individuals who require AAC to learn to read

and understand a wide range of texts.[2,6] Although the acquisition of decoding skills and sight-word recognition skills is necessary to meet this goal, acquisition of these basic skills alone is not sufficient. Individuals who require AAC must learn to read and understand written texts. Copeland and Keefe described four factors that are critical to reading comprehension: (a) the ability to decode and recognize sight words fluently; (b) the ability to comprehend the vocabulary and language structures of the text; (c) the ability to activate prior experiences and world knowledge and relate these to the text; and (d) the ability to use metacognitive processes to monitor comprehension and make adjustments as required to build understanding.[34] Individuals who require AAC may be at risk for experiencing difficulties with reading comprehension because of difficulties in one or more of these areas. The National Reading Panel identified seven evidence-based strategies that enhance reading comprehension, including comprehension monitoring, summarization, graphic organizers, question answering, question generation, and cooperative learning.[11] Individuals who require AAC may benefit from instruction in one or more of these strategies with appropriate adaptations to support the use of AAC; future research is required to determine the relative effectiveness of these strategies for individuals who require AAC.[2,10]

EARLY WRITING SKILLS

To access the full benefits of literacy, individuals who require AAC must not only develop reading skills but also writing skills. To write, individuals who require AAC must integrate knowledge and skills across several domains: (a) knowledge of basic narrative structure or other genres to organize stories or other written texts; (b) language skills to structure sentences in the stories appropriately; (c) phoneme segmentation skills to break down the words in sentences into component sounds; (d) knowledge of letter-sound correspondences to code the sounds of language into written form; and (e) handwriting, keyboarding, or other access skills to produce or locate/select the required letters/words.[2] Clearly, learning to write is a complex process. To reduce the learning

demands initially, Light and colleagues proposed using familiar motivating story books to help structure writing experiences: (a) Initially, individuals who require AAC read simple story books with repeated lines (e.g., *Brown Bear, Brown Bear; I Spy* books) and fill in selected slots in the story with their own text (e.g., Red pig, red pig; I spy a bug). (b) Later, individuals who require AAC fill in short narrative sequences in longer story books with repeated plot lines. (c) Finally, students build their own simple narratives with a beginning, middle, and end based on their experiences, familiar books, or picture prompts.[35] As a first step in writing simple narratives, the student communicates a word/story, using a picture display, a SGD, or by signing. The instructor then provides oral scaffolding support to help the learner encode the text by saying each word slowly and segmenting the phonemes while the learner listens and selects the appropriate letters from an accessible keyboard. At this early stage of writing, sound spellings are accepted; the instructor models conventional spellings for the learner as required. Gradually, the supports are faded as the learner develops greater competence. The texts generated by individuals who require AAC are published as books and scanned into their AAC systems for independent reading or use in shared reading with adults or peers, thus illustrating the power of reading and writing.[35]

OPERATIONAL SKILLS AND KEYBOARDING SKILLS

To encode written text, individuals who require AAC must be able to produce the required letters. Although some individuals who require AAC may have sufficient motor dexterity to learn to use handwriting, most will use some form of computer technology with a conventional keyboard or adapted keyboard. In either case, individuals who require AAC must learn the operational skills to hold a pencil and form the letters legibly or to locate and select the target letters from a keyboard as accurately and efficiently as possible. To build operational skills, the instructor may introduce the keyboard incrementally as soon as the learner has acquired a few letter-sound correspondences and may use the keyboard during instruction

in letter-sound correspondences to build greater fluency.[2]

In summary, the development of reading and writing skills is a complex process that rests on the integration of knowledge and skills across a variety of domains. Instruction typically targets several skills at a time, starting with instruction in phonologic awareness skills and letter-sound correspondences; gradually adding instruction in decoding and sight-word recognition; and providing numerous opportunities to apply these basic skills during meaningful reading and writing activities throughout the instructional process.[2]

INSTRUCTIONAL TECHNIQUES

Individuals with complex communication needs require organized and consistent instruction to maximize the acquisition of literacy skills and to ensure the successful integration of these skills in the context of meaningful reading and writing activities.[11] Literacy instruction is most effective if it is two-pronged, including (a) direct instruction in basic skills and (b) numerous opportunities to apply these skills in the context of meaningful reading and writing activities.[11]

Direct Instruction in Basic Skills

Direct explicit instruction in basic skills uses a most-to-least prompting hierarchy to support errorless learning and provides numerous opportunities for learners to practice skills: (a) First, the instructor models the skill for the student. (b) Then, the instructor provides guided practice with scaffolding support to assist the learner in completing the skill successfully. (c) Finally, the learner has opportunities for independent practice. This "model, guided practice, independent practice" instructional sequence has been used effectively to teach a wide range of skills to learners with and without disabilities.[36,37] These instructional procedures have been applied successfully to teach conventional reading and writing skills to students who require AAC as well.[2,12,13]

Opportunities to apply skills in the context of meaningful literacy activities. To illustrate the

power of reading and writing, build motivation, and ensure generalization of skills, individuals with complex communication needs require numerous opportunities to apply their basis skills in the context of meaningful reading and writing activities. For example, as students acquire letter-sound correspondences, sound blending skills, and some basic decoding skills, they are provided with opportunities to participate in shared reading activities where the instructor reads part of the text, pausing to allow the student to apply newly acquired skills by reading words from the text. These opportunities build motivation and also enhance generalization of skills to a range of reading and writing contexts.

ADAPTATIONS FOR INDIVIDUALS WHO REQUIRE AAC

Unfortunately, most of the literacy curricula used in the schools require oral responses from students. However, it is possible to adapt literacy instruction to meet the needs of individuals who require AAC, including those who have significant speech and motor impairments. Task adaptations to bypass the need for oral responses, to allow alternative access/selection techniques, and to support systematic error analyses to determine areas of difficulty have already been described in the earlier section "Skills Targeted for Instruction."

In addition to these adaptations, individuals who use AAC may also require adaptations to compensate for their lack of speech sound production.[2] When young children are learning to read and write, they typically sound out words aloud to help them link the written language to the spoken language. Individuals who require AAC may be unable to produce some or all of the speech sounds in the target word, they may be unable to sound out words aloud, and they may have difficulty with subvocal rehearsal as well, resulting in increased demands on working memory and increased challenges in learning to decode and encode words.[13,21] They may benefit from external scaffolding support in the initial stages of instruction to compensate for their lack of access to oral rehearsal and to help them build subvocal rehearsal. Specifically, it may

be helpful if the instructor models saying the sounds aloud for the student while encouraging the student to say the sounds in his or her head subvocally. Research suggests the effectiveness of this type of oral scaffolding support during literacy instruction.[2,12,13]

Summary

Designing appropriate literacy instruction for individuals with complex communication needs requires (a) systematic targeting of appropriate skills, known to contribute to positive literacy outcomes; (b) implementation of effective evidence-based instructional procedures, known to result in successful skill acquisition; and (c) development of appropriate adaptations to accommodate the unique needs of individuals with complex communication needs. Recent research suggests that with these three components in place, we can successfully support individuals who require AAC in the acquisition of conventional literacy skills.[2]

IMPLEMENTATION OF LITERACY INSTRUCTION: A CASE EXAMPLE

Often, individuals who require AAC present a complex array of disabilities that make it challenging to implement effective literacy instruction. This single case study illustrates the specific implementation of literacy instruction with a student with multiple disabilities to demonstrate the positive outcomes that can be achieved with appropriate instruction. Katie was 8 years old when she was referred for literacy intervention by her parents. She had a rare genetic disorder that resulted in significant speech, motor, visual, and hearing impairments. Specifically, she had delayed skeletal maturation and used a power wheelchair for mobility. The joints of her hands and fingers were fused; Katie was able to produce broad gestures and point with her hand, but she was not able to isolate her index finger. Katie had a cleft palate that had been surgically repaired when she was an infant. She had undergone surgery for a tracheostomy as an infant and was ventilator-dependent for the first years of her life. By the time we started literacy instruction, Katie had been weaned off the ventilator, but she had a permanent tracheostomy to support respiration and the handling of secretions. Katie was fed via a gastrostomy tube. She had a bilateral moderate to severe sensorineural hearing loss and used hearing aids and an FM system to enhance her performance at school. She was diagnosed with cortical visual impairment (CVI), a neurologic condition that causes significant visual impairment despite normal ocular functioning. Katie wore glasses and performed best when tasks were familiar and she was motivated and engaged.

Katie communicated via multiple modes including gestures and a small number of sign approximations, facial expressions, vocalizations to attract attention, and a SGD, specifically a Mercury (Tobii; Dedham, MA) with Speaking Dynamically Pro software (Mayer-Johnson; Solana Beach, CA). The Mercury was programmed with a few hundred words and phrases represented by photographs and Mayer Johnson Picture Communication Symbols (PCS; Mayer-Johnson, Solana Beach, CA) and organized in a grid layout of rows and columns. Katie typically communicated telegraphically, expressing a single concept via sign approximations, gestures, or her SGD. She understood basic instructions and simple *who, what, where* (WH) questions presented in context. She performed best when her partner used augmented input to support her comprehension, that is, when her partner used speech to provide input in conjunction with AAC (e.g., signs or PCS).

Katie attended a life-skills classroom; she had a nurse to care for her medical needs and a classroom aide to support her educational needs. She was not receiving literacy instruction when we started intervention. Katie's parents were very committed to her and wanted her to have the opportunity to develop literacy skills and attain her full potential.

Baseline

Prior to initiating literacy intervention with Katie, we assessed her skills over a series of sessions to determine appropriate starting points and instructional procedures. Katie's phonologic awareness skills, her knowledge of letter-sound correspondences, her decoding

skills, and her sight-word recognition skills were assessed using the task adaptations described earlier. Her performance did not exceed chance levels of accuracy (i.e., 25% accuracy) for any of these skills. These results are not surprising as Katie had not received literacy instruction within her classroom program. Clearly, she required systematic instruction to build her literacy skills.

Literacy Instruction

After the assessment was completed, we began to provide literacy instruction to Katie in one-to-one sessions for 30 minutes twice a week at her school. Ideally, Katie would have been receiving more intensive literacy instruction on a daily basis; however, there were numerous scheduling constraints given the wide range of support services that she required. This case study illustrates the gains that can be made under less than ideal instructional conditions. Designing appropriate literacy instruction for Katie posed significant challenges because of the complexity of her speech, motor, hearing, and visual impairments. Instruction focused on direct instruction in the basic skills described earlier along with numerous opportunities for Katie to apply these skills in meaningful reading and writing activities. The instructional procedures for each skill followed the sequence described earlier (i.e., model, guided practice, independent practice). All tasks were adapted so that Katie could participate actively in instruction by signing, pointing to PCS/letters/words, and/or using her SGD. All text was presented in large black font (i.e., 80- to 90-point font) on yellow background to reduce glare, increase contrast, and maximize Katie's visual attention. The instructor used Katie's FM system and used augmented input to support Katie's comprehension; explanations were presented in sign or traditional orthography as well as orally. A written visual schedule was used to structure the instructional session.

The Initial Phase of Literacy Instruction

As summarized in Table 1, the first phase of literacy instruction with Katie focused on direct instruction in the following skills: knowledge of letter-sound correspondences, sight-word recognition of high-interest vocabulary, and single-word decoding skills using the letter-sound correspondences that she had acquired. Given Katie's hearing loss, phonologic awareness skills were not targeted in isolation; rather visual supports (e.g., written letters) were provided to reduce the auditory processing demands and assist with learning. With the visual supports provided, this task resembled the guided practice stage of single-word decoding instruction: The instructor presented a written word to Katie, pointed to each of the letters in the word in sequence, and said the letter sounds orally slowly extending each sound 1 to 2 seconds. Katie needed to look at the letters, listen to the sounds, blend them in her head to determine the target word, and then sign the word or select it from an array of AAC symbols. In addition, to direct instruction in basic skills, Katie had numerous opportunities to apply these skills in the context of meaningful shared reading activities.

LETTER-SOUND CORRESPONDENCES

It was anticipated that it would be challenging for Katie to learn letter-sound correspondences given her hearing impairment. Instruction was conducted in a quiet setting using her FM system to maximize her auditory performance. Letter-sound correspondences were introduced incrementally following the general principles proposed by Carnine et al.[32] The instructional sequence was modified (i.e., *m, b, a, c, r, i, t, o, e, g, d, l, u, s, n, h, p, f, j, w, v, y, z, q*) to reflect the following additional considerations: (a) those sounds that would be more difficult for Katie to hear were spaced in the instructional sequence and were introduced later in the sequence once she had acquired some of the letter sounds that were easier for her to discriminate; and (b) bilabials (e.g., *m, b*) were taught first because these sounds provided Katie with clear visual speech reading cues in conjunction with the auditory cue. The letter-sound correspondences were introduced slowly over time to ensure mastery.

SIGHT-WORD RECOGNITION SKILLS

It was anticipated that Katie would require some time to learn the full range of letter-sound

Table 1 Intervention Sequence to Teach Literacy Skills to a Student with Multiple Disabilities Who Required AAC

Instruction	Targeted Skills	Outcomes
Phase 1. Introducing conventional literacy skills, months 1–7; 20–25 hours of instruction	Knowledge of letter-sound correspondences	Acquired nine letter-sound correspondences
	Sight-word recognition of high-interest words	Read 30 words with > 90% accuracy
	Single-word decoding skills with known letter-sounds	Applied single-word reading skills in shared reading activities with > 90% accuracy
	Opportunities to apply skills in shared reading activities with personalized books	
Phase 2. Reading and writing simple texts, months 8–16; total of ~55 hours since the start of instruction	Knowledge of letter-sound correspondences	Acquired 11 new letter-sound correspondences (total of 20 letter-sound correspondences)
	Sight-word recognition of high-interest words	Learned ~30 new words (total of 60 words)
	Single-word decoding skills with known letter-sounds	Applied reading skills in shared reading activities with > 90% accuracy
	Opportunities to apply skills in shared reading activities with a wide range of books	Participated in peer reading buddy program
	Skills to read and understand simple sentences	Read simple sentences with > 90% accuracy
	Keyboarding skills	Located letter-sounds on the keyboard with > 80% accuracy
	Skills to type simple personalized stories using assistive technology	Typed short sentences with some oral scaffolding support

correspondences and to develop competence with single-word decoding given the complexity of her multiple disabilities. Therefore, we introduced her to instruction in sight-word recognition of high-interest words (e.g., *horse, swim, baby*) to allow her to participate in shared reading activities at an early stage. Instruction in sight-word recognition skills followed a paired associate paradigm with Katie learning to pair the written word with the appropriate sign, PCS, or other AAC symbol.

SINGLE-WORD DECODING SKILLS

As Katie acquired letter-sound correspondences, she was introduced to instruction in single-word decoding using the letter-sounds that she had acquired. Instruction followed the model, guided practice, and independent practice sequence described earlier. Katie indicated her responses using signs, PCS, or other AAC symbols.

SHARED READING ACTIVITIES

Early in the instructional process, we introduced Katie to opportunities to participate in shared reading activities where the instructor read the text and then paused for Katie to read a target word and sign it. These activities were designed to clearly illustrate for Katie that reading was meaningful and fun. Initially, we used personalized books that reflected Katie's experiences and interests. Katie's knowledge of vocabulary and sentence structures was limited when we started literacy

instruction. Using personalized books ensured that Katie had the background knowledge and experience to understand the text. These high-interest books were very simple initially with just a simple sentence on a page with a single target word highlighted in yellow for Katie to read. New vocabulary and language concepts were taught to Katie as required within the context of these reading activities.

OUTCOMES OF LITERACY INSTRUCTION

After the first 7 months, ~20 to 25 hours of instruction, Katie was well on her way to becoming a reader (see Table 1): (a) She had acquired nine letter-sound correspondences (i.e., *m, b, a, c, r, i, t, o, e*) and identified these letters with > 90% accuracy from a field of 8 to 10 letters when the sounds were presented to her orally. (b) She was able to read (decode or recognize by sight) ~30 words (e.g., *mom, dad, dog, cat, baby, eat, play, swim, horse,* etc.) with > 90% accuracy. (c) She loved to participate in a wide range of shared reading activities and demonstrated > 90% accuracy reading targeted words (~30 different words). (d) She demonstrated competence reading target words in shared reading activities even when the book was a new one that she had not read previously and the pictures/photos were covered so that she could not rely on them for contextual cues. Katie had clearly established the basic foundations for further literacy development, and she was highly motivated with respect to literacy learning. Her literacy gains resulted in increased expectations within her school program; her class placement was modified so that she was included in a regular education class with learning support provided on an individual basis.

Next Phase of Literacy Instruction

Over the next 9 months (months 8 to 16 since the start of instruction), we continued to target instruction in letter-sound correspondences, sight-word recognition skills, and decoding skills as described earlier. In addition, we placed increased emphasis on Katie's application of her skills in the context of meaningful reading and writing activities (Table 1).

BOOK READING ACTIVITIES

Katie was highly motivated by book reading activities. During this next phase of literacy instruction, we increased the number of words targeted for Katie to read in each sentence so that she was regularly reading at least three to four words per sentence; over time, she began to read simple sentences independently (e.g., *Katie loves mom and dad. Mom and dad eat.*). When we had started literacy instruction with Katie, her communication was telegraphic. She relied on single words to express herself and omitted the functors (e.g., prepositions, articles, conjunctions). As Katie developed her reading skills, we used the written texts to introduce her to new vocabulary and sentence structures including basic functors. Thus, literacy learning served to scaffold her language learning. At this stage, we also introduced Katie to a much wider array of written texts, including books that focused on the classroom curriculum (e.g., social studies, science) as well as commercial storybooks of interest to Katie. As Katie's literacy skills and language skills progressed, she began to demonstrate interest in more complex, age-appropriate topics (e.g., the TV show *Hannah Montana*). We also introduced a range of books with age-appropriate topics to facilitate interaction with her peers.

EARLY WRITING ACTIVITIES

At this stage of instruction, we expanded instruction to target not only reading skills but also writing skills. We introduced Katie to assistive technology for writing, specifically the Dynawrite (DynaVox Technologies, Pittsburgh, PA). She was able to access the standard keyboard using the side of her finger/hand, angled toward the keyboard. Keycaps were used to label the keys with lowercase letters using bold black font on yellow background to maximize her visual performance. We used the keyboard during letter-sound correspondence activities to enhance Katie's fluency.

During writing instruction, Katie had the opportunity to produce her own stories using photos or pictures of interest to her to provide a context. Initially, the instructor modeled typing a short story for Katie. Then Katie had the opportunity to produce her own story with guided practice: First she signed her

story/message; then, the instructor provided scaffolding support to help her encode her story/message into text; specifically, the instructor said each word slowly, elongating the sounds to help Katie segment the words into their component sounds; Katie selected the letters that represented each of the component sounds; as she completed each word, she spoke the message out on the Dynawrite and pointed to each word in sequence. Initially, Katie's written texts were very short telegraphic messages; the instructor modeled how to expand these telegraphic messages into slightly longer, more complete texts. As Katie developed greater literacy and language skills, she began to produce longer sentences (e.g., *I love dad. Katie and dad and mom.*); she was less dependent on the instructor's oral scaffolding support to segment the phonemes in words. Katie's written texts were made into short books that she could share with adults and peers. The emphasis was on using writing to communicate with others in ways that were meaningful and fun.

OUTCOMES

After a total of 16 months of instruction, a total of ~55 hours since the start of instruction, Katie demonstrated substantial progress in her literacy and language skills (Table 1): (a) She had acquired a total of 20 letter-sound correspondences (all except *q, v, w, x, y,* and *z*) and located these on a standard keyboard (an array of 26 letters plus punctuation and function keys) with greater than 80% accuracy. (b) She read (decoded or recognized by sight) more than 60 words with > 90% accuracy. (c) She participated actively in reading activities with a wide range of texts, reading known words with > 90% accuracy with adults or peers. (d) She used assistive technology to type simple one-sentence "stories" or messages (e.g., *I love mom. Dad eat.*). With appropriate instruction, Katie had developed into a reader and a writer. Her acquisition of literacy skills resulted in increased expectations and learning opportunities at school. She had opportunities to participate in a general education classroom, and her reading and writing activities incorporated current classroom themes (e.g., life on the prairies). With ongoing instruction, it is expected that Katie will continue to develop her reading and writing skills. With improved literacy skills, she will accrue significant benefits in all aspects of her life—increased language skills, enhanced communication skills, improved educational access, expanded access to information and digital technologies, increased employment opportunities, enhanced self-esteem, improved social networking, and increased societal perceptions of her competence.

FUTURE CHALLENGES

Katie is just one of several individuals who require AAC with a wide range of disabilities (e.g., cerebral palsy, autism, developmental apraxia, Down syndrome) who have benefited from the literacy instruction described in this paper.[2] It is difficult to overestimate the power of literacy skills for individuals who require AAC like Katie. As a field, we have made significant advances in the development of effective evidence-based instruction to teach reading and writing skills to individuals who require AAC.[2,8,31,33] We now know what skills to target, what instructional procedures to implement, and what adaptations are required to successfully teach individuals who require AAC to read and write. The results for Katie and others demonstrate that we *can* teach literacy skills successfully to individuals who require AAC.[12,13,38] Now, it is our challenge to do so. We need to successfully translate these research results into daily practices in schools, homes, and community programs so that individuals who require AAC have the opportunities and effective instruction needed to ensure that they develop the literacy skills that they require to attain their full potential.

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