Integrated Communication and Literacy Instruction for a Child with Multiple Disabilities

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This longitudinal case study examined the communication and literacy learning progress of an 11-year-old boy with severe speech and physical impairments related to cerebral palsy. Theoretically driven literacy assessments revealed unforeseen literacy capabilities. Integrated use of voice-output augmentative communication technology led to improved communication skills as well as increased demonstrations of literacy capability. Systematic instruction addressing the child's weaknesses and strengths resulted in literacy gains across 2 school years.

Children with severe or multiple disabilities face many challenges in learning to read and write. Beyond the obvious difficulties of learning to read without the ability to communicate clearly with parents or teachers, or learning to write when it is difficult to hold a pencil, more subtle barriers exist. Parents and teachers may doubt the child's capability to learn (Coleman, 1991; Light & McNaughton, 1993). Professionals may be unaware of ways that assistive technologies can benefit written language learning or use (Koppenhaver, Steelman, Pierce, Yoder, & Staples, 1993). Classrooms, curricula, and instruction may be organized in ways that intentionally or unintentionally reduce or eliminate literacy learning opportunities (Johnston, 1994; Koppenhaver & Yoder, 1993; Mike, 1995).

The literacy needs of children with severe or multiple disabilities have been consistently underserved and overlooked. The mainstream literacy research community has evidenced growing attention to the learning and instruction of diverse students, but diversity has been operationally defined as children with learning disabilities or mild mental retardation, African American children, or children for whom English is a second language (see, e.g., P. M. Cunningham & Allington, 1994; Hiebert, 1991; Keefe, 1996; Roller, 1996), not as children with severe disabilities. Further, the disability research community has been increasingly concerned with the full inclusion of children who have severe disabilities, but literacy instruction has received little or no attention (see, e.g., Calculator & Jorgensen, 1994; Downing, 1996; Haring & Romer, 1995; Stainback & Stainback, 1996). Public schools attempting full inclusion and trying to teach all children to read and write find the task daunting, particularly when faced with children requiring assistive technologies in the classroom (Pierce & Porter, 1996).

If public schools are to be expected to truly implement instructional programs respecting the *diversity* of students in *full inclusion* classrooms, a minimum of two changes is required, one conceptual and the other practical. Conceptually, diversity and full inclusion must be held to higher standards. If students with severe or multiple disabilities are to continue to be excluded from discussions of diversity in the classroom, then a term like *selective diversity* would be more accurate. Practically, if students with severe and multiple disabilities are to be fully included, then academic instruction must become a central piece of the research and policy agenda. Reading and writing instruction are of critical importance across a full inclusion curriculum that takes academic instruction seriously.

As an initial attempt to better understand the challenges and rewards of implementing a full inclusion program addressing literacy instruction for a child with multiple disabilities, a case study was undertaken. Specifically, the study sought to examine (a) how the regular classroom might influence the literacy learning of a child with severe speech and physical impairments, (b) what role(s) assistive technology might play in school-based literacy activities, and (c) how direct interventions might influence the child's literacy learning.

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Method

Participant

Jordan was an 11-year-old boy with severe speech and physical impairments who was fully included in a fourth-grade classroom when the study was initiated. He was perceived as having moderate to severe cognitive impairments. He has spastic cerebral palsy, limited use of his hands, mild to moderate visual impairments, and is nonspeaking. He uses a motorized wheelchair for mobility, but requires occasional assistance in maneuvering the chair. Jordan requires substantial assistance in meeting basic care needs such as eating and toileting.

Setting

Jordan attended an elementary school in a small town in the Piedmont region of North Carolina. There were approximately 25 students in both his fourth- and fifth-grade classes. His fourth-grade teacher had a degree in elementary education, 1 year of teaching experience, and no prior experience or training in teaching students with disabilities. His fifth-grade teacher was a first-year teacher who had received a degree in elementary education after several years working as a journalist. During third, fourth, and fifth grades, Jordan was accompanied at school by a full-time aide. Prior to her placement with Jordan, the aide had no experience working with children with severe disabilities. The aide attended to Jordan's personal care needs, adapted instruction provided by the classroom teacher, provided direct instruction to Jordan in literacy and other subject areas, moderated interactions between Jordan and others, and acted as a teacher assistant for the entire class, which included 3 other children with mild to moderate disabilities.

The fourth author, who was the county-wide inclusion and assistive technology coordinator, consulted with Jordan's classroom staff. The coordinator was also Jordan's mother and former teacher. Fourth grade marked the first year that she had not been a member of the classroom staff since Jordan had begun attending public school in second grade.

A special education consultant teacher was responsible for writing and ensuring implementation of Jordan's Individualized Educational Program (IEP). She regularly consulted with the mainstream teachers. She provided little direct instruction to Jordan during fourth grade and more during fifth grade.

Procedures

Design. The study employed a qualitative case study design to enable holistic examination of the various classroom processes and instructional components within the natural classroom context. The thorough descriptions of the participant and surrounding context required by a qualitative case study design (Merriam, 1988) were believed to hold more promise than traditional literacy assessments for capturing Jordan's literacy progress. Collaborative research (Schensul & Schensul, 1992) and participatory action research (Whyte, 1991) strategies were employed to enable the first and fourth authors and school personnel to conduct the study in the day-to-day classroom context with a concurrent goal of improving instruction (Smulyan, 1988).

Data Collection and Analysis. Participant observation by the first author constituted the primary data collection technique in Year 1 of the study. Researcher roles varied from basic management (e.g., pushing Jordan in his wheelchair or monitoring the cafeteria) to classroom instruction (e.g., assisting in planning instruction or serving as a substitute teacher). More than 200 hours of observation and intervention were conducted. Unstructured interviews, document review, and a researcher journal (Webb & Glesne, 1992) served as additional data sources. Follow-up classroom visits, interview, and document review were the primary data collection techniques employed in Year 2. Constant comparative analysis of data (Glaser & Strauss, 1967) was employed throughout the course of the study.

Results and Discussion

Assessment

Communication History. Jordan's family had always viewed communication as a major concern. Because of his multiple speech, physical, visual, and cognitive impairments, Jordan was unable to communicate even basic wants or needs consistently. He was, however, able to use a limited number of idiosyncratic gestures, signs, vocalizations, and communication symbols to communicate with his immediate family and close friends. His mother, who holds a master's degree in assistive technology, continually monitored advances in technology and had persevered in her attempts to identify appropriate, technology-based communication systems for more than 8 years prior to the study.

When Jordan was 10 years old, his parents and an augmentative and alternative communication (AAC) team (including school personnel, a regional children's hospital, and regional manufacturing representatives) had determined that a Dynavox might be an appropriate AAC device for him. The Dynavox, which looks like a laptop computer, is a dedicated, voice-output communication device with a touch screen display. Selection of picture or picture-word combinations on a touch screen produces a spoken message via built-in speech synthesis as well as a written message via visual display. The Dynavox had been selected for Jordan because of its options for auditory scanning. Instead of touching the screen directly, Jordan could listen as the Dynavox's speech synthesizer whispered each of the available messages to him. When he heard the message he wanted, he could use his head to activate a switch that directed the Dynavox to speak that message aloud. The device could also be set up so that Jordan could move his hand across the selections, without touching them, and only hear the whispered cue at those locations where he rested his hand.

Jordan did not use the auditory scanning feature for long. Instead, he tried to use his hands to directly select messages

on the touch screen. His parents and the AAC team were surprised, because direct selection on the touch screen, without the auditory cues, required motor and visual skills they believed Jordan did not possess. Nonetheless Jordan persisted in using his hands to access six locations on the touch screen. Consequently, the AAC team worked with the Dynavox regional representatives to develop a means to improve his accuracy. In the end, a splint with a pointer attached at his palm was molded to fit on his forearm and hand. The pointer allowed Jordan to immediately increase the number of locations he could access from 6 to 12.

When Jordan began using the splint he could physically touch the screen, but he was slow, and it was unclear that the resulting messages were selected intentionally. In these initial stages of use, Jordan's mother preprogrammed messages that were depicted on the touch screen with pictures (e.g., Jordan touched a picture of a television, and the spoken message was, "My favorite show is *The Andy Griffith Show*"). Jordan used this process to share news between home and school. For example, when he performed in a play at church, he told his friends by touching a picture of a church. Given the preprogrammed messages, Jordan could communicate relatively easily and quickly within a narrow range of topics that others selected, but he could not produce novel questions or comments of his own.

Education. Jordan had attended a special school serving only students with significant disabilities until he was 7 years old. Then he had enrolled in a typical elementary school, where he attended a special education class for 1 year before entering a mainstream second-grade class. By the time Jordan was in fourth grade and received his Dynavox, he was participating in his third year of full inclusion in general education classes.

At home, in preschool, and in the primary grades, Jordan had listened to stories read aloud to him and had participated in a limited fashion by means of an adapted switch and loop tape with a single message (like those of answering machines). With this arrangement Jordan could say a single message during the reading experience (e.g., a repeated line in the text, a directive like "read it again," or a comment like "that's funny"). In second and third grade, Jordan began to receive formal literacy instruction with a small group of children who were poor readers but only some of whom had identified disabilities. The instruction was based on a language experience approach in which the children dictated and otherwise created the texts used for instruction throughout the week. This approach had been selected due to Jordan's apparent delays in language development and the teacher's previous success using the instructional strategy with other poor readers. Jordan and his group followed a weekly cycle of activities based on a story the group authored on Monday of each week. Each student was responsible for contributing one line to the story given a sentence frame provided by the teacher. As the children dictated sentences, the teacher wrote them on sentence strips. Jordan participated by eye pointing to a limited set of words that filled in the blanks of the sentence frame. Throughout the week, the students used the teacher-made sentence strips, as well as sentences they copied from the model, to read and reread the story as a whole, as individual sentences, and as individual words. Jordan participated throughout by eye pointing to index cards with individual words printed on them. While his peers cut apart sentence strips and recreated sentences by sequencing the pieces, Jordan eye pointed to cards to indicate to his teacher or aide the order he wanted.

When Jordan began fourth grade with his Dynavox, he was able to become a more active participant in the reading group. The words and sentences were preprogrammed into his Dynavox, and he was able to touch the screen in order to read aloud his own or the other students' sentences. For the first 9 weeks of fourth grade, Jordan participated in this small group reading lesson. The educational team, wanting to keep him with the regular class as much as possible, then began to question whether the higher literacy and communication demands of the general fourth-grade classroom might provide a more appropriate learning environment.

It seemed that Jordan should be able to participate actively and independently in the fourth-grade class by using the Dynavox. In second and third grades, the adults had worked to predict the messages that Jordan might want or need to say during a lesson. They then created word and picture cards to display on an eye-gaze frame. When Jordan needed or wanted to contribute to a lesson, he eye pointed to one of the cards, and an adult spoke the corresponding words for him.

It was conjectured that with the Dynavox, Jordan would have wider and continual access to all of the prestored vocabulary and phrases and not have to rely on another person to interpret his eye pointing lesson by lesson. However, a decrease in Jordan's participation was reported during the initial 9 weeks of fourth grade. The instructional team found it difficult to predict Jordan's daily vocabulary needs and program the Dynavox to accommodate them. There appeared to be two primary reasons for the difficulty. First, the course content covered in fourth grade was significantly greater than that of the second and third grades. Second, the fourth-grade teacher relied heavily on classroom discussions and other conversation-based formats during most lessons. It was becoming increasingly clear to Jordan's parents and the educational team that he needed to develop skills in generating his own messages in order to be an active participant in the class.

Jordan's skill in selecting one of six messages on the Dynavox was improving, and the Dynavox's dynamic screen provided him with the means to independently access as many six-message screens as his mother and the educational team could program. The next problem was increasing Jordan's communicative competence so that he could generate his own messages. Jordan's mother contributed the first two solu-

tions. First, she programmed the Dynavox to include an accessible alphabet display for Jordan. A standard keyboard layout would not work because the squares were too small for Jordan to either see or touch accurately. Working with the six-location screen Jordan could access, she grouped four or five letters to a square on the first screen. When Jordan touched a square with a group of letters, the Dynavox's dynamic display produced a new screen in which each of the letters was displayed individually on a square. When Jordan selected a letter on this screen, the letter name was spoken by the Dynavox's speech synthesizer. Given this layout, Jordan had independent access to all 26 letters of the alphabet for the first time.

A second solution was to create banks of words grouped onto screens in the Dynavox by category. Jordan accessed these word groups via a message that appeared on each screen of his Dynavox called "clue." When Jordan touched the "clue" square on the Dynavox, the speech synthesizer said, "I want to tell you something that is not on my Dynavox. Let me give you a clue." On the next screen, Jordan had a choice of describing the word, providing a category for the word, finding the word in a dictionary, or trying to spell the word by providing the initial letter. When Jordan selected "describe," he was able to provide clues such as "it looks like," "it smells like," and "it feels like." The category square allowed him to tell to which of 10 categories (e.g., food, people, holidays) the word fit in. The dictionary square allowed him to look for the word in an alphabetically arranged dictionary of thousands of words. Finally, selection of the spelling square allowed him to access the alphabet setup previously described. Jordan now had access to a core vocabulary of hundreds of words he would need to produce novel messages.

These alphabet and clue organizations, or setups, provided access to the tools of communication, but the problem remained how best to teach Jordan to use them in a generative manner. Most of the educational team did not expect that Jordan would ever learn to use the setups in an efficient manner. Annual speech–language assessments reported significant language delays that would interfere with Jordan's ability to retrieve words stored by category or in the alphabetical dictionary. Classroom performance and educational assessments provided no indication that Jordan's literacy skills were sophisticated enough to allow him to use the alphabet page to spell words to construct his messages.

Language and Literacy. The plan to improve Jordan's language and literacy skills began with a careful assessment of his skills in both areas. Language assessments indicated significant delays (5.6-year age equivalent on the Peabody Picture Vocabulary Test–Revised [PPVT-R; Dunn & Dunn, 1981]), but the educational team wondered about the accuracy of the PPVT-R score given Jordan's classroom performance. Two plausible alternative explanations seemed to be that (a) Jordan may have become fatigued before reaching his true ceiling, given that the test administration had begun at the 3-year age level, and (b) Jordan's poor visual perception and processing difficulties may have made it difficult for him to distinguish relatively subtle picture details as the vocabulary targets became more complex.

Assessments of Jordan's literacy skills began informally. Standardized measures of reading skills do not exist for children with severe speech and physical impairments. As a result, informal measures of reading used with children who do not have disabilities were adapted. The primary assessment tool was an informal reading inventory called the Basic Reading Inventory (Johns, 1994). It includes graded word lists and graded passages with open-ended comprehension questions. Both the word identification and comprehension portions were adapted to make it possible for Jordan to respond in a multiple choice rather than an open-ended format.

Reading assessment was driven by J. W. Cunningham's (1993) model of reading processes. In this model, silent reading comprehension is viewed as the ultimate goal of both reading and reading instruction. All other reading skills instruction (e.g., seeking correspondences between letters and sounds or using context to determine pronunciation and meaning of unknown words) is provided in order to improve reading comprehension, not each subskill in isolation. The model proposes three components of successful silent reading comprehension: word identification, language comprehension, and print processing of text (as opposed to processing words in isolation).

Jordan's silent reading comprehension was examined first in the assessment process. He proved unable to read silently or demonstrate comprehension at the primer, or initial, level of the Basic Reading Inventory. Assessment continued in order to determine which component(s) were responsible for the observed difficulties in silent reading comprehension.

Word identification was assessed in two ways using the graded word lists in the Basic Reading Inventory. First, four of the words from the list were printed on cards and displayed on an eye-gaze frame. Jordan had to eye point to the printed word spoken by the evaluator. In this format, he identified 19 of 20 words on the primer list and 11 of 13 on the first-grade list. This level of success was unexpected and the team posited that Jordan might be applying his knowledge of initial or final letter–sound correspondences to identify the correct answer without really being able to read the entire word. The task was modified to assess his ability to read whole words rather than to identify individual letters and sounds. Simple colored pictures depicting the words from the graded word lists were displayed in four quadrants of an eye-gaze frame. For each word on the list, a display was created that included at least two pictures with labels beginning with the same sound as the target word (e.g., for the target word *boat,* the four pictures included *boat, ball, cat,* and *barn*). Jordan was shown a flash card with the target word printed on it and asked to "find the picture that means the same thing as this word." Jordan responded by eye pointing to the picture.

Jordan correctly identified 7 of 8 primer level words and 6 of 10 first-grade-level words.

To further investigate Jordan's word-level knowledge, he was given a developmental spelling test (Ferroli & Shanahan, 1987). Jordan was directed by the examiner: "I am going to say a word that I want you to spell. You will use your spell page (i.e., the letter groupings in the Dynavox described earlier) to spell the word as best you can. When you are finished spelling the word, look at me." It was important for Jordan to indicate completion to prevent the evaluator from unintentionally cuing him. The target words and Jordan's spellings are shown in Table 1.

The assessment was terminated when Jordan grew physically tired from the task of selecting letters on his Dynavox, although the original test includes six additional words. Jordan's spelling revealed that he had some understanding of both initial and final letter–sound correspondences in words. Jordan's performance on these word identification assessments exceeded the expectations of the educational team. Their interest in teaching him to use the alphabet setup on his Dynavox increased dramatically.

Assessment of language comprehension consisted of a test of text-based listening comprehension and the PPVT-R general test of receptive language ability reported earlier. The listening comprehension assessment consisted of graded passages from the Basic Reading Inventory. Based on Jordan's reading comprehension performance, PPVT-R age equivalent, and teacher report, testing was begun at the primer level. After the passage was read aloud, questions were asked and each possible response was pointed to as it was read aloud. Jordan then indicated his answer with the pointer on his hand splint. Possible responses had been printed in the four corners of a piece of transparency film. Transparency film was used so that Jordan could eye point if he appeared to fatigue from pointing with his hand splint.

Jordan responded by hand to all of the questions at the primer, first-, and second-grade levels with 100% accuracy. At the third- and fourth-grade levels, he responded by hand with 90% and 80% accuracy, respectively. Testing was then stopped because (a) it was quite difficult to create viable multiple choice responses to the increasingly inferential questions accompanying higher level passages, and (b) it had become clear that listening comprehension was a relative strength for Jordan and not a factor contributing to his silent reading comprehension difficulties. It was interesting, however, to note the discrepancy between Jordan's performance on the PPVT-R and the assessment of text-based listening comprehension. This strengthened the belief that some feature of the PPVT-R led to the depressed scores and added the possibility that the lack of context in the PPVT-R, a test of one-word receptive vocabulary, also may have confounded Jordan's performance.

The assessments as a whole revealed that Jordan had literacy skills (and perhaps language skills) beyond the team's expectations. He demonstrated an awareness of letter–sound correspondence in his identification and spelling of single words. His use of the alphabet setup on his Dynavox for the developmental spelling test demonstrated that he understood how it worked, and the educational team was excited to learn that Jordan could listen to instructional materials with age-appropriate understanding.

Intervention

Fourth-grade. Jordan's assessment profile revealed that he had benefited from the previous years of literacy instruction. The modified language experience approach coupled with extensive opportunities to hear others read connected text may, in fact, have allowed him to develop his relative strength in listening comprehension skills. The next step was to create a program that would improve his silent reading comprehension ability. The educational team determined that Jordan required direct instruction to improve his word identification skills, opportunities to read connected text to build his print-processing skills, writing instruction to help him integrate what he learned, and continued opportunities to hear text read aloud in order to maintain or improve his listening comprehension skills. The question remained whether such a program could be provided more effectively in a pull-out reading group or in the general fourth-grade classroom.

Two of the primary components of intervention were present in the general fourth-grade class already: regular reading and writing of text. Students in the general classroom engaged in sustained silent reading (SSR) of self-selected materials for 15 minutes daily. At the onset of the study, Jordan spent this time listening to a peer read. The peer was conscious of allowing Jordan to look at the book as it was read, but it was unclear whether Jordan could see the print given his visual impairments. Occasionally, Jordan had a few words from the book programmed into his Dynavox so that he could interact with others about his reading, but the programmed vocabulary was difficult to use for more than completion of oral cloze statements or specific questions from the partner. Jordan's physical abilities made it impossible for him to hold or read a book independently. Alternatives for independence were explored, but given classroom resources and Jordan's needs, a peer was the best initial option.

In order to provide Jordan with increased opportunities to read independently, the nature of this reading time was changed. First, books were written at a primer level about his personal inter-

TABLE 1
Results of Jordan's Test of Developmental Spelling

Target word	Jordan's spelling
back	beca
sink	scrvl
mail	ml
dress	soua
lake	lca
peeked	patp

ests. These books incorporated photographs from family day trips and vacations (Jordan's favorite book was about a radio station his family had visited) and pictures from magazines accompanied by captions written by educational team members who made the books. Second, several books were programmed into Jordan's Dynavox to provide him with ready and independent access to easily read, interesting texts. With this story vocabulary programmed into the Dynavox, Jordan could retell plot events, comment more specifically about the text, and enrich his own writing.

Word-level instruction focused on teaching Jordan about the connection between letters, sounds, spelling patterns, and words. The primary instructional strategy was Making Words (P. M. Cunningham & J. W. Cunningham, 1992). This strategy is intended to systematically teach children to attend to the similarities and differences between words and parts of words. Students combine and recombine a limited set of letters (usually six) to spell in guided sequence a series of one-, two-, three-letter, and longer words until the entire letter set is combined to spell one word. Target words are sequenced so that (a) only one letter has to be changed to create a new word, or (b) existing letters have to be rearranged to create the new word. Making Words initially was developed for mainstream group instruction, and children manipulate cards with individual letters printed on them. However, with a few modifications, it was equally appropriate for Jordan. Each set of six letters was preprogrammed onto a single screen of his Dynavox, allowing Jordan to spell each word independently.

Making Words lessons for Jordan were selected from words he encountered in silent reading or as part of the fourth-grade curriculum. Jordan began by making one- and two-letter words (i.e., *I, a, it,* and *at*) to increase his success with the task. Three-letter and longer words were initially more problematic. As Jordan selected letters, they appeared in the message bar at the top of the Dynavox screen. When Jordan finished making a word, he touched the message bar, and the word was spoken. The relative slowness with which Jordan selected individual letters on the screen, as well as apparent difficulties concentrating on the sounds without an adult elongating them (e.g., ***kuh-aaah-tuh***), consistently prevented him from going beyond three- and occasionally four-letter words. Eventually a decision was made to monitor Jordan's success with one-, two-, and three-letter words. Once he had demonstrated that he could spell such words both in the Making Words activity and in compositions, his Making Words time was devoted to spelling the longer words. In this manner, Jordan did not waste instructional time practicing skills he had already mastered.

Jordan was encouraged to apply his increasing word knowledge by using invented spelling skills (i.e., independently spelling unknown words the way he sounded them out in his head) while composing. Prior to this use of invented spelling, Jordan's writing had been limited to copying words, spelling words as an adult elongated the individual sounds in the word, or selecting whole messages from his Dynavox. For example, he had contributed preprogrammed social studies vocabulary when his classmates were creating North Carolina brochures. Three days later, when Jordan's classmates were making a North Carolina mural, Jordan typed labels for all of the pictures that his classmates had drawn. The words had not been preprogrammed into his device, so the aide wrote the words on a white board for him to copy. Jordan used the spelling pages in his Dynavox to select individual letters that he copied from the model.

More than 4 weeks later, however, after Jordan had completed Making Words activities many times and the staff had begun to understand the importance of composing and using invented spelling, Jordan wrote captions for a book about frogs. His classmates cut out pictures of the life cycle of a frog. The teacher told them to put the pictures in order, color them, and write simple sentences to explain the cycle. The product was intended to be a simple book that young children could read in order to learn about frogs. Jordan's pictures were cut out and mounted on construction paper before the activity began. The pictures were put on his eye-gaze frame, and Jordan eye pointed to the one that came first, second, and so on. Then he selected individual letters from his Dynavox spelling setup to compose the following captions: "aeg" (*egg*), "ptl" (*tadpole*), "lks" (*legs*), "fg" (*frog*), and "fg bk" (*frog book*). The product lacked conventional spelling accuracy, but Jordan had generated his own thoughts and messages, not copied those of others.

The educational team, Jordan, and his peers were quite excited by the "fg bk" (*frog book*). Given the clear context provided by the frog text, everyone knew what Jordan was writing. The educational team learned from this experience the importance of knowing the context of Jordan's writing. Subsequently, he began to systematically incorporate preprogrammed words and messages with invented spelling in his compositions. The combination allowed Jordan to reveal the general topic using words spelled conventionally and then elaborate using his invented spellings.

Self-selected silent reading, Making Words, and writing with invented spelling were the core of Jordan's fourth-grade literacy instructional program. The general education class provided an opportunity for Jordan to engage in sustained reading and writing, so there had been no need to create a small group or pull Jordan out of the general class to meet those needs. Jordan completed the Making Words activities instead of participating in the class's spelling instruction. Because Jordan's literacy skills were delayed by several years, it was natural to have Jordan complete a different type of word study.

Fifth-grade. When Jordan entered the fifth grade the team determined that he needed to continue with the intervention plan set out the previous year but with added emphasis placed on reading and writing connected text. With her background in journalism, Jordan's fifth-grade teacher firmly believed in the importance of writing for all of her stu-

dents. Each day began with almost a full hour of writing. When the students were asked to write to a prompt, the context was clear, so Jordan could compose using his invented spelling. When the children were asked to select their own topics, Jordan began with preprogrammed words and messages so that readers would have increased context for interpreting his nonconventional spellings.

Jordan continued to have difficulty composing complete thoughts and messages. Often he selected what appeared to be random letters and words or words that fell into a single category in his Dynavox setup. In order to address this difficulty, a modeling strategy was employed. Jordan set the topic by selecting a preprogrammed message or word. His adult writing partner then wrote three or four sentences about the topic, reading aloud the words as she wrote. The adult also thought aloud to help Jordan understand the composing process. When she finished writing, she reread the text and put it away, telling Jordan, "Now it's your turn." Table 2 shows two examples of the adult's model and Jordan's subsequent writing. In the first, Jordan's writing looks very much like the adult's. Note the differences in the second.

TABLE 2
Writing Samples Produced Through Modeled Writing Process

Example 1:
Adult model:
I will call Anne tonight. I will ask her about Hannah. I hope she is fine.
Jordan's writing:
I will call Tiffany. I will ask Tiffany about school. I hope she likes school.

Example 2:
Adult model:
Candy is at Maple Street today. She takes our lunch money.
Jordan's writing:
Aggie (Dad) Mom eat lunch with Jordan. Aggie teaches PE.

Maybera *Reunion* Doug Pad **Blue** *GSA Music..*
Brney amd **picture** with people..
Barny was fny..
Hlm Lu cel hn..
Keth pad the drm..
Jono sg..
People sag..
I had fon..
I had fon..

FIGURE 1. Jordan's writing sample integrating multiple methods. *Note.* Normal font denotes words spelled letter by letter; italics denotes words written using word prediction; boldface denotes words accessed in the Dynavox.

Throughout the course of the year, Jordan's writing improved and he began to integrate preprogrammed messages, words, and invented spelling with single compositions and also started using a new strategy, word prediction. One example of his writing that combined the strategies is shown in Figure 1. Note how Jordan switches from one strategy to another in order to produce the composition.

The Dynavox includes a special feature called DynaWrite that predicts the word Jordan might be trying to spell after he types the first letter. In other words, when Jordan spelled the word *reunion,* he began by typing the letter *r.* In response, the Dynavox predicted five words that began with the letter *r* and displayed them in small boxes on the screen of the Dynavox. *Reunion* is not a very common word and was not likely to be found in that first set of five words. In such a case, Jordan typed the next letter, *e.* The Dynavox predicted five new words that started with *re. Reunion* was one of these five words. Even though Jordan could not spell the whole word, he did recognize it when it appeared on the screen. He touched the square with the word *reunion* and the whole word was typed for him in his composition.

Perhaps the most marked change in fifth grade appeared in Jordan's ability to accurately touch locations on the Dynavox screen. He progressed over the course of the year from 6 to 40 squares on the Dynavox screen. Given time to use the device purposefully at school and home (i.e., to engage in real communication) and to explore and play with it during free times, Jordan developed motor and visual skills not thought to be within his capabilities. Now he accurately touches much smaller squares, resulting in wider immediate letter or vocabulary access and an increase in communication rate. For example, Jordan no longer selects a group of letters and then an individual letter. He can directly select the letter he wants, and if DynaWrite predicts the word he desires, he can touch the whole word.

Jordan continued Making Words lessons in fifth grade during school and for homework. Making Words continued as a replacement for spelling, and the strategy appeared to be quite effective. Jordan demonstrated improved spelling across contexts. For example, he included a vowel in most words, consistently included the correct initial and final consonants, and began spelling three- and four-letter words more accurately. In the sample shown in Figure 2, Jordan was writing about what he learned in the DARE program on drug awareness at his school.

DARE

SM PEOPLE ARE BAD. SO MANY PEOPLE QUIT SMOCING. TV IS BEING BAD.

FIGURE 2. Jordan's writing sample with spelling progress.

During fifth grade, a means for Jordan to independently access books was finally devised. Previous attempts included using books on the computer, or slides, attaching sticks to pages that acted as handles for page turning, and myriad other adaptations. Finally, book pages were placed individually in plastic page protectors that were put into three-ring binders. The binder was stabilized on an easel that provided a low angle and slight rise. The easel was secured to a table top or tray using a bungee cord. Jordan's right arm was restrained and a rubber tip was placed on the end of the pointer he used on his left hand. Given this setup, Jordan could put his pointer on one of the plastic pages and drag the page from right to left in order to turn the pages.

Finding a means for independent book access was not an easy task. Like the other intervention strategies described above, and the many others used throughout the school day, finding answers to problems related to independent access and interaction is difficult, but not impossible. Jordan found success with each of the intervention strategies described above not because they were some magic panacea. He found success because he was provided with a means and an opportunity to be actively engaged in learning about and using written language.

Conclusions

Jordan has shown progressive improvement in his acquisition of literacy and language skills through the years. We could make a number of speculations as to why and how this came to be. We choose to speak to some of the obvious: (a) Jordan was in a supportive home environment with a parent who worked cooperatively with an AAC team and was unusually persistent across many, many years in seeking to match technology with Jordan's demonstrated abilities; (b) Jordan was placed in a classroom where he was allowed to participate interactively with same-age peers in academic aspects of the curriculum; (c) Jordan's teachers provided interactive reading and writing experiences for him to increase his skills in word finding, spelling, and overall; (d) Jordan's teachers were provided with information and assistance regarding the provision of literacy instruction for a child with severe disabilities; (e) the Dynavox was used consistently and modified repeatedly when needed to provide Jordan with independent access and a means to interact during instruction; (f) the expectations and attitudes of teachers and parents clearly showed Jordan that learning to read, write, and communicate were important to his well-being; and (g) the consistent successes in school provided a solid foundation for acquiring self-confidence and motivation, which in turn demonstrated themselves in Jordan's increased motor, visual, and communication skills through his use of the Dynavox.

Jordan is a clear example of the value of integrating reading, writing, and language instruction for the acquisition of literacy and communication skills. His experience demonstrates the ways in which a strong, supportive environment with positive expectations of parents and teachers assisted in the attainment of skills, including motor and sensory, that are infrequently observed in children with multiple disabilities.

Jordan will continue to need further practice across a number of areas. First, he will need further instructional emphasis at the word level with strategies such as Making Words; spelling accuracy should be a goal but not to the point of discouraging spontaneous story writing. Second, he should be encouraged to read silently in and out of school to ensure the practice that makes for increased reading comprehension. Finally, he should be provided with ongoing instruction and practice in written composition. This will lead to further improvements in reading, writing, communicating, motor skills, visual motor coordination, and response rate.

The future for Jordan is positive. If he is continued in an inclusive environment with similar positive expectations, access to appropriate technology, provision of instruction driven by careful and ongoing assessment, and opportunities to interact, we can expect continued growth in his reading, writing, and communication.

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