Assistive Technology Resources for Children and Adults with Disabilities

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Solutions

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Providing Emergent Literacy Instruction for Students with Significant Disabilities, Including Cortical Vision Impairment: Predictable Chart Writing

Article Series Summary - *When and how to make literacy adaptations for students who have complex communication needs combined with Cortical Vision Impairment can be a difficult task that requires systematic inter-professional collaboration. This article series will focus on the daily emergent literacy routines recommended by Erickson (2017): shared reading, Predictable Chart Writing, alphabet/phonological awareness activities, independent writing, and independent reading. To build confidence and meaningful engagement, augmentative and alternative communication is integrated throughout. The following article describes a component of emergent literacy instruction: Predictable Chart Writing.*

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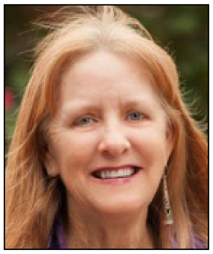

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DEANNA K. WAGNER, MS/CCC-SLP, is a speech-language pathologist with over 30 years experience providing consultations and training in the area of assistive technology with an emphasis on augmentative communication. She works with educators and families to achieve goals in the area of AAC selection and implementation through a contract with TherapyOne (nominated two years in a row for the McLean-Yoder Award for Professional Excellence). She has been recognized for volunteer efforts and AAC support services to adults at the non-profit organization VALLEYLIFE, including various Stories of Ourselves literacy projects. She is co-director of Out and About: AAC in the Community. She has presented at local, national, and international conferences.

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INTRODUCTION

This series of articles is specifically focused on the importance of providing emergent literacy instruction to students with significant disabilities including cortical vision impairments (CVI) and complex communication needs (CCN). *Emergent* literacy instruction is quite different from conventional literacy instruction. Conventional literacy instruction focuses on areas such as sight word identification, phonics, spelling, and learning formal comprehension strategies. Emergent literacy focuses on all of the foundational skills that precede conventional literacy, such as simply learning that print carries meaning, how books work, what it means to be a writer, alphabet knowledge and sound awareness skills. Due to their vision, verbal and physical issues, students with CVI have had extremely limited experiences with reading, writing and language. Many of them clearly need rich emergent literacy instruction. Erickson (2017) suggests that emergent literacy comprehensive instruction should include: shared reading, independent reading, independent writing, alphabet instruction and shared writing. Communication opportunities using AAC must be woven throughout each of these areas. Instruction needs to be designed in such a way that CVI does not become the gate keeper, limiting literacy learning. This article, along with future articles, will focus on how to provide such instruction for each one of the areas outlined by Erickson (2017).

OVERVIEW OF CORTICAL VISION IMPAIRMENT

CVI is a neurological disorder that impacts the visual processing of information in the brain. It is frequently undiagnosed or unrecognized due to multiple physical/cognitive impairments. In the past decade, knowledge about CVI has grown rapidly (Roman, 2018; Lueck & Dutton, 2015). According to Roman-Lantzy (2018), there are 10 CVI Characteristics: Color preferences, visual field preferences, need for light, need for movement, problems with visual complexity and visual novelty, problems with using vision to guide their reach, visual latency, atypical visual reflexes and problems with distance viewing. Students can be assessed for the level of impact of each characteristic using the CVI Range Assessment Tool. The 10 characteristics can be used to guide intervention and adaptations; each student will have different needs based on their characteristics. Students' abilities within and across the characteristics determine their severity of CVI. In broad terms, Roman-Lantzy (2019) refers to three different phases of severity of CVI. Phase 1, Building Visual Behaviors, describes students who have little functional vision and are learning to simply use their vision to look at something. Phase 2, Integrating Vision and Function, describes students who are learning about what they are looking at and attaching meaning. Phase 3 describes students who have a great deal of vision but require specific instructional support as he/she is Developing Visual Curiosity. For more information about the general implications for literacy, refer to our previous article in this series (Hanser, Musselwhite & Wagner, 2019). It important to work with a Teacher of the Visually Impaired (TVI). The TVI can support a preferred learning media assessment to help the team make modifications and enhancements through visual, auditory, tactual and/or kinesthetic means. This assessment will give input about the visual complexity of tasks, environmental variables and information about how to present text to students, such as the font style, color, size and number of items that should be presented in an array.

SHARED WRITING, INCLUDING PREDICTABLE CHART WRITING

Writing is a necessary part of literacy. However, many students with significant disabilities, including those with CVI and CCN have never experienced writing that allows them to create their own ideas. Professionals may believe that students need to possess specific cognitive skills, vision skills and/or physical skills in order to engage in writing. However, writing does not have to be a visually heavy task, as many of the important concepts can be taught auditorily and through movement and tactile input. Writing does not have to be a physically taxing task – there are assistive technology solutions for these problems. Once accommodations are made, literacy can be the true focus of instruction without being restricted by students' vision or physical issues. The previous article about emergent literacy (Hanser, Musselwhite, & Wagner, 2019) referenced the concept that no student needs to be "ready" to engage in literacy, which includes writing. Shared writing, in which the teacher works with students to co-construct written materials, is an important part of early literacy experiences in typical primary grades. In this 'language experience' approach, teachers work to integrate reading, writing, speaking and listening. Predictable chart writing is the perfect example of this interrelationship, and can be made accessible to all students, including students with CVI.

Predictable Chart Writing (Hall & Williams, 2002) is a multi-level activity that addresses the needs of emergent readers and writers, as well as early conventional readers and writers. There are no prerequisites to predictable chart writing. Students with CVI don't have to know how to write in order to engage in this activity. They will learn about writing by being a part of the Predictable Chart Writing process. It is a powerful, fun group writing activity that results in a simple classroom book for students to share and re-read during shared reading and/or independent reading.

Predictable Chart Writing (PCW) is a five-day process and is especially suited to students who need emergent literacy instruction, including students with CVI because:

- It is a consistent routine. Students with CVI, complex bodies, medical complications and complex communication needs (CCN) benefit from daily routines (Bruce & Bashinski, 2017).
- Each lesson is interactive, and supports building social engagement and relationships which is especially important

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for students with CVI, who need to learn that they can impact others (Hagood, 2008).

- It provides repetition, but with plenty of variety across the five different days to support students in growing their skills across time.
- Materials developed are personally meaningful, which may support students with CVI who have challenges with visual novelty.
- Students with CVI can engage in all of these steps with visuals and/or through auditory channels.

PCW is not a 'mastery' based process. Students do not have to demonstrate a level of competence on Day 1 before moving on to Day 2. While each lesson has a slightly different focus, the same underlying skills are addressed across all of the lessons. It is important to not skip a step, as critical learning will be lost. Another important point, is that the predictable chart – the sentences and resulting book – are all text based. Symbols are not placed in the writing. Symbols can be used for communication during predictable chart writing, but text is used for the reading and writing components.

GENERAL STRATEGIES FOR THE PREDICTABLE CHART WRITING PROCESS

Model, Invite and Move On: Throughout the lessons, staff should:

- Model how students can fully participate, such as using communication systems, alternative pencils, words or tactile symbols. When modeling, adults can use flashlights to highlight items. Adding additional auditory explanations does not necessarily reduce the complexity of the task. Even students with CVI can be visual learners, and adding light can help engage and focus their vision on specific targets. When modeling on boards that may be visually complex due to the number of items, an occluder can be used to block out other information around the target item. Many students with CVI have difficulties processing things that are complex – using occluders can help to minimize the complexity.
- Invite students to share at each step, such as adding to the chart (Day 1), looking or listening for features (Day 2), or helping to create the book (Day 5).
- Move On: If after modeling and inviting the student to contribute without getting a clear response, it's important to move on to the next item. All students, including those with CVI need to have multiple opportunities to understand what they need to do.

Focus on Inner Voice: This is one skill that students are developing throughout the whole process. For all students, including those with vision issues, the use of "inner voice" should be emphasized so that students can learn that you read in your head. Teachers can say, "I'll say it out loud and then you say it in your head." The teacher reads out loud and then pauses to give students a chance to "read."

Think Outlouds: The staff should use "think outlouds" to verbally describe what they are thinking and how they select an idea to share. These "think outlouds" help make the invisible thought processes apparent to our students. Think outlouds are especially helpful for students who can't see, as they are only required to listen. However, if you are using visuals, be thoughtful when you show them. Many students with CVI have trouble looking and listening at the same time. After you are done speaking, pause and give students the opportunity to look, do not require looking. Keep in mind that students who have difficulties processing visual information may also have trouble understanding complex verbal explanations; it may be helpful to keep the language simple. While this is a primarily an auditory activity, explanations can be supplemented with sign, gestures, and movements.

Partner Assisted Scanning: All students need a way to communicate throughout the PCW process. Many students with severe physical challenges, CCN and CVI may end up use "partner assisted scanning". This communication strategy is especially helpful for students who do not have a clear access method. In partner assisted scanning, the helper (called the partner) scans through the student's choices. The partner slowly lists out and/or points to the students' choices. When the student hears or sees what they want, they make some type of response. Students can respond in numerous ways: smile, body movement, vocalization, wide eyes, or a simple voice output device programmed with "that's it." Students with CVI can use auditory partner assisted scanning which requires no vision. It is important to go through the student's choices a number of times so that they can listen to and think about what they want. Be sure to repeat them in the same order and pause between each one. Always include "something else" as the last choice, as the student may want something else that is not in the list of choices. For more information about partner assisted scanning, Linda Burkhart's website provides a wealth of information: http://lindaburkhart.com/index.php/handouts .

Attribute Meaning: This is a strategy we naturally do with young children without disabilities who are learning and not sure what they are supposed to do. The adult verbally comments on what they see the student doing, and attaches meaning to it. For example, when a student appears to be randomly and repeatedly hitting their swtich, the teacher may respond to the student by saying, "I see you hitting that switch A LOT! It looks like you have something exciting to say. Ok, everyone let's listen!" Many of our students need this kind of feedback about what they are doing.

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PREDICTABLE CHART WRITING – A 5 DAY PROCESS

The five-day process of predictable chart writing includes these steps:

Day 1: Write the Chart
Day 2: Read the Chart
Day 3: Cutup the Sentence
Day 4: Be the Sentence
Day 5: Make the Book

DAY 1: WRITE THE CHART

On Day 1, as a group. the class writes the chart using a predictable sentence frame, such as "I like _______." Each student is responsible for coming up with one idea to complete the sentence frame. Student's call out their ideas and the teacher writes the sentence frame and then each student's contribution. Teachers may use an alternative pencil to point out the first letter of the target word, or of the student's name. However, this should not take time away from the goal of having students share their ideas of what to add. The teacher writes the student's name after their sentence. Throughout the lesson, the teacher reads and re-reads the sentences out loud while pointing to the text, modeling that print is read from left to right and top to bottom. While reading, the teacher can use an occluder or a flashlight to call attention the words, however, it is not necessary for students with CVI to clearly see the words. They can see the movement of the teacher and the movement of the light which will help them understand how we read print. (See image1)

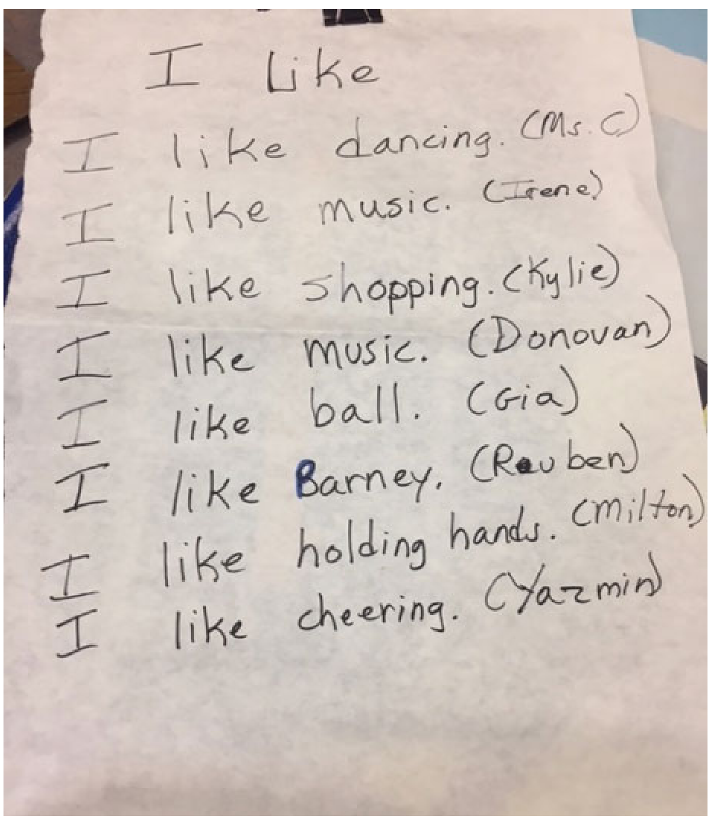


Image 1: Anna's Class Chart

Teaching Goals: One of the main goals of this lesson is to teach students about a fundamental element of writing: generating ideas. This is also a chance for students to share their ideas with their classmates. Another goal is concepts about print; students hear/see the teacher write down their ideas. They learn that writing is purposeful and that speech maps onto print.

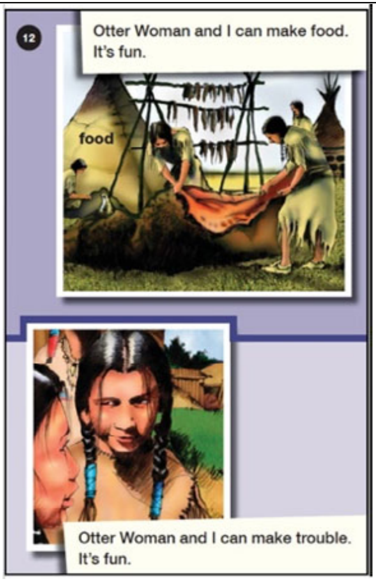
Selecting Sentence Frames: Teachers need to carefully select the sentence frame. When starting out, sentence frames should be short with 3-4 words. If sentence frames are too long, students will have difficulty completing the upcoming lessons. Common starter sentence frames are: "I Like _____," and "I Can ______." The sentence frames below provide ideas; the items in parenthesis indicate what can be used if students have a robust AAC device/system.

I like I like (people: jobs, family; things: animals, vehicles; actions: sports) I like to (actions) I like to eat… I like to drink… **I need** I need… I need (fun) I need to (actions) I need a (things) Negate with DO NOT **I can** I can… I can go (places) I can (actions) I can eat (foods) I can (thinking/sensing/telling verbs) Negate with **NOT**	**I am** I am a (social roles): (people: family/friends/jobs/character) I am (feelings) I am (describing words: colours, positive/negative, looks, feels, sounds, tastes, smells, size & speed, opposites) I am (verbs) **I see** I see… I see (places) I see (things: animals, nature, vehicles, food, body parts) I will see (things: sports, music, toys) I want to see… I hope/wish/pretend/imagine to see… (before a field trip or outing) I saw (after a field trip or outing)

Table 1: Sample Sentence Frames from Erin Sheldon

Sentence frames can also be linked to academics or books that the class is reading. For example, Ms. Jordan created the following 'She Can' book based on the text *Sacagawea (Readtopia, from Don Johnston Inc)*. After reading the 'She Can' book several times, students created a connected text titled 'I Can,' describing all of their abilities. (See Table 2)

Communication Needs: Students need to be actively engaged, with a way to communicate their ideas. When it is time to write the chart, they need to be ready to communicate their



	She Can She can make a boat. She can make food. She can make trouble. She can walk. She can ride. She can talk. She cannot fly!	**I can** I can I can I can I can (group or individual chart)

Table 2: Sample PCW Charts Related to Text

idea, whether it is using a robust AAC device or a simple voice output device that has been pre-programmed with the student's idea. This can be done in multiple ways. Students using a robust AAC device/system should use what is already on the device (or in their communication book) to generate an idea to complete the sentence frame. They may locate favorite foods, toys, games, or activities to complete the sentence: "I like ___." It is important for adults to model locating possible ideas on the device. While the team is still exploring options for the most appropriate customized robust AAC system for each individual, students can be given paper based classroom versions, verbal choices or even activity-specific pictures. Another source of ideas could be a vocabulary word wall developed across a unit; students will have some familiarity with these because they have been used for other activities. Or, the very last option could be offering "on the fly" post it notes with possible ideas. Partner assisted scanning can be used for any of these to help student to indicate what they want.

Lesson Logistics

It is important to plan where the chart will be composed, such as the computer, Smartboard, Chart Paper, or an iPad. While Smartboards offer larger text, a bright background, and the ability to highlight items, for many students with cortical vision impairment this may not be sufficient, as the Smartboard may not be within their viewing range. To support students with vision issues, helpers can use an iPad, tablet or even a Smart Phone to take an image of the Smartboard and bring it closer. Helpers can enlarge and crop the image to focus on a specific area, as well as use "Markup" on the image to provide accessible visual supports, such as using preferred colors to draw around the shape of the word(s). Drawing around the word adds visual information as augmented input as a student is learning about words and letters. It is not being recommended here as a visual discrimination matching task nor a sight word identification drill, this is just as an opportunity for meaningful exposure to text and letters in the context of writing a sentence.

Writing the Chart

Prior to the students calling out their ideas, the teacher and even a few staff members should model writing their own sentences. Staff should use the tools that their students will be using. Then students dictate their ideas and the teacher writes them down. While writing, she can do think outlouds about what she is writing, the words, the letters and make personal connections. Prepare for it to be chaotic and confusing – that's okay when getting started!

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CLASSROOM VIGNETTE: DAY 1 - WRITE THE CHART

Allison's 1st Grade Classroom is studying dogs. They have had therapy dogs visit the classroom and have done a number of shared readings with dog books. During their readings, they have been making a list of words that describe dogs.

Allison introduces the sentence frame, 'Dogs are ______', and talks about what they have been learning about dogs. She models the process by writing the first sentences for the chart and does think outlouds while writing. She then tells them to break up into small groups for 15 minutes so they can each come up with a word about dogs. (They break up into small groups because many of her students use switches and need extra time. It is difficult for them to make choices in large group setting while everyone is waiting and watching them.)

Small Group Choicemaking:

Allen has severe CVI and is just learning to use his vision (Phase 1). He uses partner assisted scanning to choose a word from the 'dogs describing words list' generated from shared readings. The helper slowly says each word. Allen doesn't do anything with his switches the first time she reads the list. He is hanging his head down and he appears to not be attending. She reads through the list a second time. Allen uses his switch to say "no - not that" to everything. Staff thinks that he may be hitting his switch randomly and is not paying attention. The helper reads through it again and talks/does think outlouds about the words connecting them to the book and his experiences. She reads through it a 4th time and he raises his head and clearly clicks his switch to say "that's the one" when he hears the word "cute." The helper records his choice onto a single message device to prepare him to share with the class.

Large Group Follow-Up. After 15 minutes, the students return back to the large group with their ideas identified on their AAC devices or pre-programmed on a single message device (or written on a paper if there is no device). Students share their ideas and Allison writes them down. Each student has their idea recorded in a separate sentence. She writes the student's name after their sentence (which she chants and spells out loud while she writes). She models that when they share an idea, it gets written down and then they can read it. After each sentence, they stop and re-read it, clap it, chant it and cheer the name of the student who wrote that sentence. Clapping and chanting emphasizes the sounds. This is helpful for all of the students, but especially for the students who cannot see the text. During chanting and cheering in Allison's class, many of her students with CVI frequently are observed with their heads down, as it is difficult for them to look and listen at the same time. When the chants are done, many of them pick up their heads and smile because they love the singing and chanting.

DAY 2: RE-READ THE CHART

On day 2, as a group, the class reads the chart multiple times. Their purpose is to look and/or listen for specific text elements. As the teacher reads through the chart the students can indicate if they see or hear the target element.

Selecting Elements to Highlight: Prior to the activity, the teacher chooses 2-3 different elements, such as finding two letter words, a capital letter, words that rhyme, a word that has the /p/ sound, finding the word "I", or finding the letter "d." For students with CVI, visualizing the text is not necessary as the goal is to listen for a specific element.

Teaching Goals: Because of the multiple re-readings, there are multiple opportunities to teach concepts about print, such as pointing and modeling that speech maps onto text, text goes from left to right and text goes top to bottom. Sound awareness is also a focus, as students are listening for specific words and sounds.

Communication Needs: Students should be using their AAC devices to comment. Partner assisted scanning can also be used, with the teacher reading a few lines, and the students using a single-message device to call our messages such as: "that's it!"; "I heard something"; "no not that"; "That doesn't sound right." Students can also listen for core words in the sentence stems such as I, not, can, and like.

Lesson Logistics: Materials to support Day 2 include: The chart that was written in the previous lesson, along with bold colored markers to mark/highlight the target elements. Or the chart may be on the computer, tablet or the Smartboard. A flashlight or laser light may help in pointing to specific elements (e.g., words, letters, punctuation) without obscuring it while pointing. For students with CVI, similar to Lesson 1, an iPad can be used to take a photo of the chart and that can be highlighted in Markup.

CLASSROOM VIGNETTE: DAY 2 - READ THE CHART

At the end of morning meeting in Allison's class, they move to the Day 2 lesson. She starts the lesson by saying: "OK, everyone let's read the chart we wrote yesterday! Remember we wrote all of those sentences that started with "dogs are." And you finished the sentences with your ideas! So, we are going to read the chart and look for different things. Let's start by just reading through our whole chart. We'll practice reading it in our heads. I'll say it out loud and then you say it in your head." (As she does that, she points to her head.)

Allison reads the first sentence out loud and uses a flashlight to point at and tap each of the words. "Dogs are cute. (Allen)" Then she silently reads the sentence while she points and taps each word. Next she goes on to the next sentence: "Dogs are beautiful. (Gary)" Gary vocalizes with excitement when he hears his sentence. Again, the teacher points and taps each word while she silently reads the sentence and goes to the next sentence. There is rhythm to the reading. Helpers may also tap on students' chairs or laptrays to help with the tapping as the words are being read outloud and silently. She does this with the whole chart.

The students in Allison's class are very new to this process and most of them have never written before, so she specifically starts with a slightly simpler item to look for.

"We're going to read our chart again, but we're going to do something different! This time we are going to read it to find students' names. When you hear a name, let us know! You can use your switch or your communication device." She models the process with two sentences. For the following sentences, she pauses and invites them to try. The teacher reads each sentence slowly and gives the students time to decide if that is a student's name or not. Some students press their switches to say "that's it." She doesn't wait for the students to give the correct answer, but instead she models and teaches them how to do to it and moves on. When a student's name is identified, she circles it with a neon marker and then they cheer the name. After they have done this with all of the names, the teacher moves on to the next reading purpose. "Ok, everyone-we are going to read our chart one more time. This time we're going to listen for words that start with /d/." She repeats the process from above. Students use their same communication setup. For the part, she models the letter "d" by using Allen's alternative pencil: a print flip chart which has been modified for students with CVI who are learning to use their vision (Phase 1). The flip chart isin a binder with 26 pages; each page contains one large letter (Burkhart, 2018). Each letter is a simple font with a neon glow text effect. Every time someone hears /d/, she talks about it and models what it looks like on the alternative pencil.

DAY 3: CUTTING UP AND SEQUENCING SENTENCES

Days 1 and 2 were focused on the chart. On Day 3, students focus on their own sentences. Each student gets their sentence pre-written on individual sentence strips using the appropriate font style, color and size. Students cut their sentences apart and then learn to sequence the words to make the sentence. This activity can be done in small groups or one on one.

Teaching Goals: Students are learning concepts about print, such as concept of sentence, concept of word, left to right order, exploring syntax and checking meaning for 'what sounds right.'

Communication Needs: All students should have access to an AAC system. Single voice output devices can again be programmed with messages for partner assisted scanning, such as 'That's the one' or 'Not that' for times when students are using communication books/displays without voice output. Other target words might be 'here' or 'not' as a partner moves an indicator down the sentence. Once the strip is cut apart, target vocabulary may include examples of how we use the words 'first' and 'next' when ordering the words. We can also provide experiences talking about how/when to say, 'I made a mistake.'

Lesson Logistics: Sentence strips need to be prepared and written ahead of time in the format that is most visually appropriate for the student, whether digital on the computer or paper sentence strips. During the lesson, the sentences are cut apart or ripped apart, reinforcing the concepts of sentence and word. A dark colored pocket chart can be especially helpful when sequencing the words to create sentences. For students with CVI, the pocket chart creates a clean background for the words.

If students cannot cut sentences apart with standard scissors, they can use battery-operated scissors (available from Amazon) adapted for a switch using a battery interrupter available from a number of vendors (Ablenet, Adaptivation, Adaptive Tech Solutions, Enabling Devices). The student's switch plugs into the battery interrupter in the scissors. The student is in charge of turning on the scissors for a partner who does the cutting. For students who have trouble holding the switch down long enough to do all of the cutting, a timer box can help (examples: Switch Latch & Timer Box from Ablenet; LinkSwitch from Adaptivation). When the switch is clicked, the timer box will allow the switch adapted item to stay on for a pre-set time (e.g., 10 seconds).

Some students with CVI are attracted to the backlight of digital devices. Sentences can be setup on the computer (in PowerPoint), Smartboard (using the whiteboard or SmartNotebook software) or on the iPad. On the iPad, apps such as Sticky – simple notebooks or Keynote, allow you to make little "post it" notes with individual words on them which can be moved around.

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For more details about this lesson, see www.aacintervention.com, Tip of the Month # 5, 2019.

CLASSROOM VIGNETTE: DAY 3 - CUTUP SENTENCES

In Victoria's classroom, they have been working on a "My pumpkin is ______" chart.

She has chosen a longer sentence stem because her students have been doing well with the shorter sentences and she feels they can handle more. Before the lesson starts, her teaching assistants prepare paper sentence strips with each of the students' sentences. They are on long sentence strip paper written using markers bright blue glitter glue covering each letter. Her students enjoy touching the letters and the sparkle engages their vision.

10 minutes prior to the lesson starting, staff sets up the students with ways to communicate. They setup the students' AAC devices, make sure they are programmed with appropriate messages, and mounts and switches are in proper position. One student has an eye gaze device, another student uses her hands to access a device. Others are using partner assisted scanning to access light tech choices and have devices programmed with "yes-that's it" and "no-not that one." They also have the switch adapted scissors ready to go; none of the students in the class can hold standard scissors.

Victoria starts by saying, "we are going to cut up our sentences today and play with the words. Whose sentence should we use first?" She pauses and gives someone a chance to communicate. Alex uses his head switch to say "yes-that's it!" "Oh, good-Alex wants to go first. OK everyone, let's read Alex's sentence together. It says: 'My pumpkin is round. 'This is a sentence and it is made up of words. We are going to do something funny to Alex's sentence – we are going to use our special scissors to cut the sentence apart into words! Who wants to use the scissors?" A student vocalizes and then uses a switch to activate scissors which Victoria uses to cut off the word "round." As she cuts the word she holds it up high so the word falls down onto the desk where kids might be able to see some movement. "Oh no—we lost the word "round!" She gives the students a chance to look at and touch the word. What does your sentence say now? Let's read it: My pumpkin is." She repeats the process for each word until the whole sentence is cut apart. To teach concept of 'word', Victoria takes the word "pumpkin" and by "accident" cuts some letter off. She says, "Oh no, some letters came off our word—pumpkin turned into pump! 'Whoops – where's the tape? We need to put the word 'pumpkin' back together!!"

Next, they work on re-ordering the words. The 4 words are presented on a black pocket chart. Victoria says "Oh no, these words are all mixed up! We need to put them back in order. Alex's sentence was: My pumpkin is round. Now, it says: is round pumpkin my. Does that sound right?" She pauses and gives students a chance to look and comment, but it is not required. Alex uses his vision and is learning to understand what he is looking at (Phase 2 CVI). During this activity, his head hanging down, but has a big grin on his face. He uses a small Microlight switch (Ablenet), by his thumb to repeatedly say "No way!!!" Victoria immediately acknowledges his communication. "Oh Alex, you are right! That sentence does not sound right! Let's listen to the sentence we are trying to make is 'My pumpkin is round.' Let's listen to the sentence again. Pay attention to the first word. 'My pumpkin is round.' Let's find the word that starts the sentence: is round pumpkin my. As she reads the word, she pauses and points the flashlight at each word. She gives students a chance to call out. Although his head is hanging down, Alex looks at the words. She has them positioned on his right side where he sees the best. She accepts all answers and moves whatever word they choose to the beginning of the sentence. Each time she reads the sentence and asks if it sound right. Once they have the correct first word in place, she moves to the second word and they work together to find it using the same process.

DAY 4: BE THE SENTENCE

On Day 4, students get single words and work together to line themselves up to make a sentence. This day can be a bit more challenging due to the logistics of our students' mobility issues.

Teaching Goals: Day 4 supports learning concepts about print (such as visualizing left to right), syntax (the importance of word order), checking meaning, developing the inner voice, listening to for words and the concept of 'first'.

Communication Needs: During this activity, the students that are in the sentence will need a way to say the target word. The rest of the students need ways to choose, comment and give opinion about if the sentence sounds right. The team needs to make plans for students to have access to multimodal AAC systems at all times. Some students will use partner assisted scanning, with single message devices recorded with 'That's it' or 'Not that one'. If there are not enough single message devices, students will need to use partner assisted scanning to help their peers move in order to make the sentence correctly. When working on putting words in correct order, students will be

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working on language concepts such as FIRST, NEXT and LAST. They may be learning to ask and answer WHO questions. They may also be building vocabulary around ownership using the word, HAVE/HAS. These words should be located within a robust organized system and used during other activities to build experiences around the language being used.

Lesson Logistics: Materials include prepared sheets with individual words. These can be printed out in a glow font or even written on a small black dry erase board with a neon dry erase markers. Each student will need a single message device programmed with a word from the sentence, or a communication device where the pathway to the word is practiced, but other words are hidden.

CLASSROOM VIGNETTE: DAY 4 - BE THE SENTENCE

In Allison's class, three students are lined up at the front of the room. They will each represent one word that is part of a three-word sentence. Each student has a large paper with their word on it and each student has a single message device with the word programmed on it. For students with CVI who cannot see the words, they can hear them on the single message devices.

Allison starts out by saying, "Let's read Gary's sentence. I'll say it out loud and you say it in your head. Dogs are beautiful." We need to remember this sentence so you guys can be it!! She reads Gary's sentence three times. "Ok, let's see what words you have. Jim you are the first word—what is your word?" After 20 seconds, Jim hits the switch and says "are." "OK! Now, Allen-you have the second word—what is it?" Allen hits his switch 4x times to say 'beautiful, beautiful, beautiful, beautiful.' "Good! Now Gary—you have the last word—what is it?" Gary is excited and extends his body in his wheelchair. After 15 seconds, he relaxes enough so that he can use his arm switch to say 'dogs!'

"Ok, so your sentence is: are beautiful dogs. Does that sound right?" She pauses for students to comment. Some students say "yes that's it," and others say "no not that."

"OK, so that does not sound right. Let's listen to the sentence we are trying to make: dogs are beautiful. What word do you hear first? Dogs are beautiful. Hmm, I think the first word is dogs. Who has the word dogs?" She gives Gary a chance to chime in with "dogs," however he doesn't – instead Allen says "beautiful" 5 times. OK, Allen you said beautiful—let's see what the sentence sounds like if you go first! Allen gets moved to the first position and she has the students say their sentence: beautiful are dogs.

The students have the opportunity to comment if the sentence sounds right. Aria provides more scaffolding and says "We need to listen for the word dogs. Let's see if we can find who has that word. Gary, what do you think? What is your word?" She waits until he says 'dogs.' When he does, everyone makes a big deal about it and he gets moved to the first place. She has them say their words in order again and the class has to decide if it sounds right. They repeat the process until the sentence is correctly represented by the three students.

DAY 5: MAKE THE BOOK

On Day 5, students create the classroom book. Each student is responsible for taking their sentence and making a page of the book. This entails sequencing the words again and then illustrating the page. Ideally, classes including students with disabilities will include both light and high tech version of the book.

Teaching Goals: Students collaborate on developing reading materials that are at their reading levels, on topics that interest them.

Communication Needs: All students need to have access to a multimodal AAC system. While creating the book, instructional staff can focus on functions of communication for making positive and negative comments to tell what they want for their page, and it may be appropriate for some students to use graphics while others use tactiles to represent their words. It is important that the choices are based on the students' preferred media (e.g., sign, tactile enhancements, graphics which have been visually modified). Some students will need to use partner assisted scanning to make selections to represent their book page.

Lesson Logistics: Materials include prepared sheets with individual words, tactile symbols to represent the stem words (e.g., I like), occluders to isolate images, Perkins Brailler, PowerPoint, or apps such as Kid in Story or Click 'n Talk. Partners may also use an alternative pencil to show students how to find the first letter

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in key words or student names, as they are entered into the book. In most classrooms, there may be students who have no vision problems as well as some with vision needs. Since each student makes one page for the class book, the book will be full of pages that will look different in the method of illustration that is used. Students who have the most difficulty using their vision may need a collection of individualized books, some created as classroom charts and some from personal experiences.

CLASSROOM VIGNETTE: DAY 5 - MAKE THE BOOK

Mr. Arnold's Class

Mr. Arnold's class has been making predictable chart books for several months. This week, they made a book about trains, as that is an interest for many of his students. They used the sentence frame 'My train is ________.' Mr. Arnold first made an iPad book using the Book Creator app. For each page, the student chose the background color. When it came time to choose images, Mr. Arnold used Google search on an iPad to find images of trains. He first enlarged the image, and then used an occluder to block out the background. One student, Jeremiah, did not have sufficient vision to choose a photo for his sentence, 'My train is long.' Mr. Arnold described several possible train images and Jeremiah used a single message device to say, 'That's it' to pick one of the images. Even though Jeremiah couldn't see the image, he wanted to share his page with other students who could see the photo he chose. For some images, Mr. Arnold used 'markup' in photos to make the image easier to understand. For example, he added red lines to the long train image to show the length of the train. (See image 2)

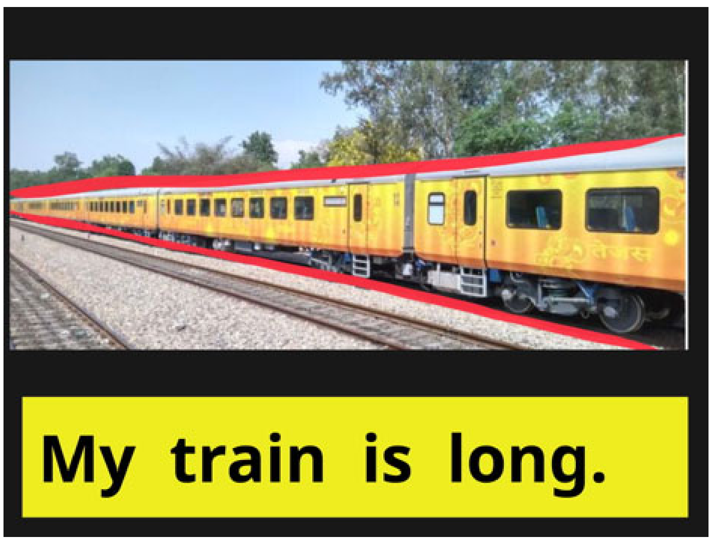

Image 2: Long Train

Image 3: Speech Button On Page

Once images were on the page, Mr. Arnold added the text box with the appropriate color background and a simple enlarged font. For some student pages, he used a neon font to support vision. He read the words of the sentence, and each student helped put the words in the correct order. Then he added a large speech button with recorded speech to read the sentence. Finally, he made the speech bubble invisible, so that he could export the book to iBooks, and the student could tap on any location to hear the text. Several of his students needed to use an iPad recipe he created (see Buell, 2016, Setting Up Recipes for Switch Access for the iPad) to use one switch to swipe (turn the page) and one switch to tap the center (read the text). Mr. Arnold then exported the book as an iBook and e-mailed it to the families. They could use iBooks on their iPad, computer or iPhone to let their student read the book at home. Mr. Arnold also made a light tech version of the book by making a PDF and printing it. He helped his student Jeremiah use the Perkins Brailler to create braille to add to his sentence, 'My train is long.' (See image3)

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NOTE: Books made in Book Creator can also be published and shared for on-line reading. Example book made by Alexa and her family during speech therapy as a follow-up to a school hygiene unit: https://read.bookcreator.com/iM9O0VXRYMQ6IX-WYCkCaLsFee882/Qg08Bu_mTvq7dczVGMyZeQ

Another example, In the Desert, could be modified into a predictable chart writing activity using the sentence frame, YOU MIGHT SEE. https://read.bookcreator.com/iM9O0VXRYMQ6IX-WYCkCaLsFee882/7XiQUPYiSlafb0szO6RWeA

SUMMARY

Predictable Chart Writing is fun, interactive, and highly successful way to teach students about the process of literacy using print. It is a nice blend of opportunities for authentic social interactions using AAC devices, as well as learning about the purposes of print and what it means to be a reader and writer. For students with CVI, vision is not required to teach these essential, foundational literacy concepts. Plus, at the end, the class ends up with a collection of personally meaningful, accessible, appropriate books—something we always need more of!

RESOURCES

Dynamic Learning Maps: Webinar on Predictable Chart Writing

https://unc.az1.qualtrics.com/jfe/form/SV_cuTdFtF1kWSbD9P

Angelman Syndrome Foundation: Communication Training Project

http://www.angelman.org/understanding-as/communication-training-series/

Play-Based and Personalized Experience Stories, for students with visual and other disabilities. http://www.pathstoliteracy.org/blog/play-based-experience-stories

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Buell, L. (2016). Setting Up Recipes for Switch Access for the iPad. 2016 Tip # 2: www.aacintervention.com.

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Collaborative Practice, and Students With Severe Disabilities. American Journal of Speech-Language Pathology, Vol. 26, pp 193–205, May 2017. Downloadable

from: https://pubs.asha.org

Hagood, L. (2008). Better Together: Building Relationships with People Who Have Visual Impairment & Autism Spectrum Disorder (or Atypical Social Development. Texas School for the Blind & Visually Impaired. ISBN-10: 1880366401, Available on Amazon — https://www.amazon.com/gp/product/1880366401/ref=dbs_a_def_awm_bibl_vppi_i0

Hall, D. and Williams, E. (2002). Predictable charts grades K-1: Shared writing for kindergarten and first grade. Greensboro, NC: Carson-Dellosa Publishing Company, Inc.

Hanser, G., Musselwhite, C., & Wagner, D. (2019). Comprehensive Emergent Literacy Instruction for Students with Significant Disabilities, Including Cortical Vision Impairment and Complex Communication Needs. Closing the Gap, October/ November. Minneapolis, MN. ■

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UPCOMING LIVE WEBINARS

IACET CEUs are provided by the AAC Institute and are available for live webinars at no additional fee (does not include sponsored webinars unless noted).

3-Part Series Beyond 90/90/90 – Supporting Students with Complex Bodies While Increasing Independent Tasks and Access

By Karen Kangas, *OTR/L, Nationally Certified, State Licensed Occupational Therapist; Seating & Positioning & Mobility Specialist, Assistive Technology Specialist; Adjunct University Faculty, Clinical Educator, Consultant, Camp Hill, PA.*

Includes 0.6 IACET CEUs

This is a consecutive 3-part webinar series, package includes access to each webinar.

Miss the first session? You can still register for all sessions, contact us to learn more!

Session 1 – The Physiology of Seating vs. the Physics of Sitting

Tuesday, November 5th, 2019
3:30 pm – 5:00 pm Central Standard Time

This first webinar will focus on the true physiology of seating and positioning. Unfortunately, most therapists have been taught to look at equipment and the student at a single point in time, as was developed as an assessment process in seating clinics for adults. However, seating in not a single point in time, nor a single position, but rather a range of postures within activity, developing within every child within their environment.

Since students with complex bodies are usually not mobile or have limited independent mobility, static postures are frequently expected. It is time to expand our knowledge of active seating and its impact on task engagement. Today we will focus on how this can happen, and what we need to learn about our student's bodies to support them in increasing their repertoire of control.

Session 2 – Implementation Strategies & their Underlying Concepts

Tuesday, December 3rd, 2019
3:30 pm – 5:00 pm Central Standard Time

This second webinar is built on the first one. Now let's take what we learned in the first session and put it to use with real students. Observing a student's postural mechanisms is challenging. These can only be observed when the student is engaged in tasks, and frequently it is that very engagement that is not occurring. How can we support activity engagement to actually observe vestibular processing?

How does the actual environment itself impact the student's engagement and/or our ability to observe their experience with sensory processing? How do we analyze this environment and how might it change to support self initiation?

Session 3 – Let's Get to Work! The Journey Required!

Tuesday, January 7th, 2020
3:30 pm – 5:00 pm Central Standard Time

This final webinar is based on the previous two in consecutive order. Today we want to explore how we can create the journey and critical pathways we need to utilize for seating and positioning within each classroom for each student for support of increased task engagement.

How to we create an assessment which not only observes the student, but also observes the environment and their interactions? Where do we start when we know we need to change, and we face such a challenging hurdle of multiple staff, lack of equipment and the challenge of limited time?

This webinar will share the actuality and real methods to get started and keep going. This will help therapists develop a plan to create increased self initiation within the classroom today, and in the future. This whole process is a process not just for our students, but a journey and a road we need to be on together.


Serving Students with Autism and Low Vision / Blindness

By Angel Black, *MM.S. Ed, TVI, Vision and Multiple Disability Educational Specialist, Special Education Service Agency, Anchorage, AK.*

And Samantha Weiland, *M.A., Autism Educational Specialist, Teacher, Special Education Service Agency, Anchorage, AK.*
Thursday, January 16, 2020
3:30 pm – 5:00 pm Central Standard Time

Includes 0.2 IACET CEUs, and/or Closing The Gap Issued Certificates of Contact Hours.

Serving Students with both visual and autism impairments is an overview of the definitions and characteristics of both visual impairment/blindness and autism diagnoses. The presenters will share case studies of actual students living in Alaska who have the co-occurrence of visual and autism impairment.

The presenters will share some of the challenges they have experienced while attempting to find ways to meet these student's unique functional needs. Presenters will also share the implementation of evidence-based methods that were used to not only accommodate the student's needs but that also contributed to their success.

Learning Outcomes:

1. As a result of the presentation, participants will be able to discern the difference between vision impairment and blindness.

2. As a result of the presentation participants will be able to define and understand the characteristics of individuals with Autism Spectrum Disorder.

3. As a result of the presentation participants will be able to identify co-occurring characteristics of individuals with ASD/Vision Impairment/ and Blindness.

4. As a result of the presentation participants will be able to utilize strategies for students who may have Autism and Vision Impairment/Blindness.

Literacy for Students who are Deafblind

By Jennifer Schroeder, *Multiple Disabilities Specialist, Deaf-blind Specialist, Special Education Service Agency, Anchorage, AK.*
Monday, November 18, 2019
3:30 pm – 5:00 pm Central Standard Time

Includes 0.2 IACET CEUs, and/or Closing The Gap Issued Certificates of Contact Hours.

This webinar will focus on showing educators different levels of literacy and ways to adapt those levels to a a student with Deafblindness. This will include stages of reading as well as stages of writing, how to determine where your student is, and how to know when your student is ready to move on to the next stage.

During the presentation, the presenter will show videos and pictures of students who are Deafblind engaged in literacy activities ranging from pre-reading skills to grade level reading as well as stage 1 writing skills through grade level writing.

https://www.closingthegap.com/product-category/upcoming-webinars/

How High Tech and Artificial Intelligence are Making Communication More Personal?

GARRETT OYAMA is a speech language pathologist based in Walnut Creek, CA with a multidisciplinary background in music, technology, and cognitive science. Graduating from Emerson College in 2014, he has given presentations in a wide variety of language topics at school districts along with co-presenting at the American Speech Language and Hearing Association Conference in 2018. He is also a touring music professional and has toured internationally in several countries. Given his multidisciplinary background, he is passionate about how concepts and technologies from other fields can be re-purposed for the use of treatments for communication disorders.

LOIS JEAN BRADY has over 25 years of experience as a practicing speech-language pathologist, assistive technology specialist and Certified Autism Specialist (CAS). Lois is a proud board member for California Communications Access Foundation (CCAF) and Board of Advisors for International Board of Credentialing and Continuing Education Standards (IBCCES).

Career accomplishments include winner of three Autism Hackathons, Benjamin Franklin Award for Apps for Autism, and an Ursula Award for Autism Today TV. In addition to Apps for Autism, she has co-authored Speech in Action and Speak, Move, Play and Learn with Children on the Autism Spectrum. She has authored two professional development courses on the topics of technology and animal-assisted therapy. Lois earned a grant through the National Science Foundation's Small Business Innovative Research program. Lois served as the principal investigator to design, build, and research a synthesized emotional communication system. Lois has joined with NewSchools Venture Fund to create EdTech Tools for all students to improve educational outcomes and quality of life. She has received additional grants and awards from Autism Speaks, ANCA and Educational App Store.

MATTHEW GUGGEMOS is the co-founder and chief technology officer of iTherapy. He is also a speech-language pathologist, certified autism specialist, researcher, and a drummer. Matthew's design ideas are guided by his professional background as a speech-language pathologist and inspired by his own research into skill mastery. Notably, Matthew received the 2013 Mensa Intellectual Benefits to Society Award for his design contributions to InnerVoice. He was director of research on a 2015 National Science Foundation Small Business Innovative Research Grant , which provided the emotional communication technology for InnerVoice.

In May of 2018, Scientia published Matthew and Lois Brady's work in an article called "Multi-Sensory Tools for Autism." This article discussed the variety of concepts woven into InnerVoice as well as Matthew and Lois's unique autism language intervention techniques.

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InnerVoice

InnerVoice is a Communication App Like You Have Never Seen Before

AUTISM

For children with autism, communication can be challenging. Drawing from years of clinical experience, speech pathologists Lois Brady and Matthew Guggemos at iTherapy, LLC are developing innovative, engaging multi-sensory communication tools that aim to improve the quality of life for individuals with communication challenges.

Autism spectrum disorder is a life-long neuro-developmental condition. Currently, one in 59 children in the USA and over one in 100 of the UK's population are born with autism spectrum disorder – and the numbers are multiplying. Autism manifests itself as a collection of symptoms and behaviors that affect the way in which individuals understand and react to the world around them. People on the autism spectrum often struggle to learn social communication skills, such as having conversations and understanding non-verbal cues, because many experience sensory processing difficulties that may interfere with their development of joint attention. Joint attention occurs when two people focus on and mutually reference an external event or object. Joint attention allows parents to look at and label something while their child associates the spoken words with the event or object.

Around 40% of people diagnosed with autism are non-verbal, meaning they inconsistently use spoken language to communicate with people around them. When children do not use language to communicate, they frequently use other forms of communication such as vocalizations, gestures, or behaviors -- which limits their ability to share their thoughts, wants, needs and feelings to others.

Recognizing the key weaknesses in current augmentative and alternative communication (AAC) apps, primarily those used by people with autism spectrum disorder, iTherapy has developed a unique educational tool called InnerVoice. It helps users learn to express emotional content and use language, whether spoken, written or signed. (See image 1)

In essence, InnerVoice is a universally designed, easy-to-use and engaging communication tool that teaches speech, language and social communication skills to people with a variety of abilities. InnerVoice can work like a typical communication device: letting your thoughts and feelings be heard and understood by others. In contrast to traditional speech-generating apps, though, InnerVoice combines artificial intelligence (AI) technology with facial expressions, emotions, tone-of-voice, written words and videos, providing a complete multi-sensory learning experience.

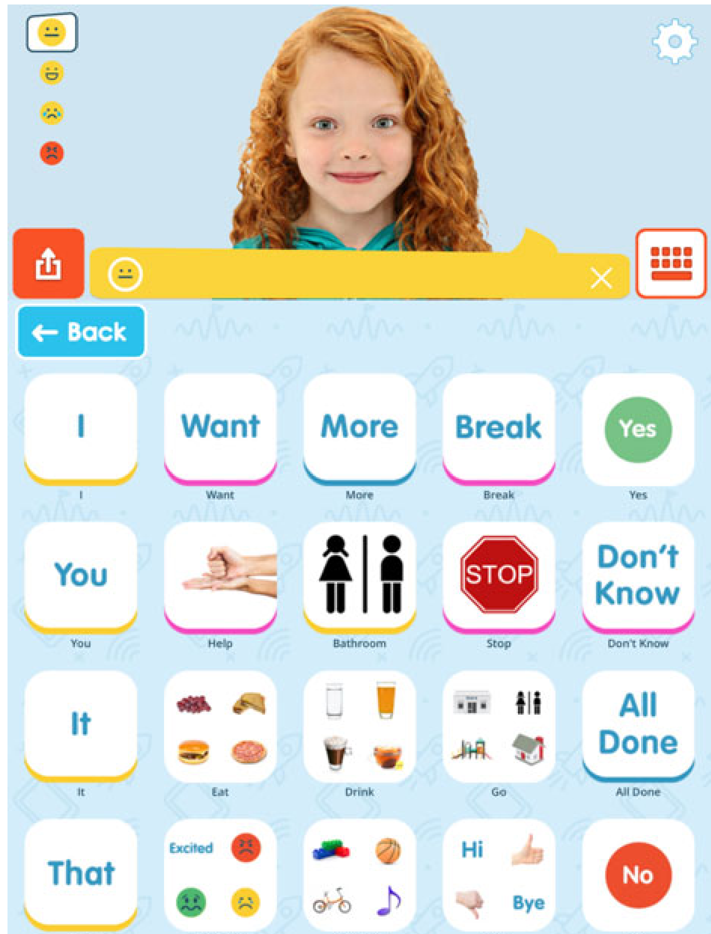

Image 1: InnerVoice is a universally designed, easy-to-use, and engaging communication tool that teaches speech, language, and social communication skills to people with a variety of abilities.

"The utility of our application far exceeds the novelty of an accurate visual avatar. We know that observing the behavior and emotions of others is critical for the learning process and this phenomenon relates directly to mirror neurons in the brain." Lois Brady, CEO iTherapy. (See image 2)

LANGUAGE ACQUISITION

The famous French philosopher, Henri Bergson, wasn't wrong when he referred to the human brain as a 'reducing valve', which filters the overwhelming stream of stimuli into a more comprehensible reality. According to the psychologist and Nobel Prize

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Image 2: Take a photo of yourself, a toy, a drawing, and watch it come to life through facial animation, expressions, and movements.

winner Daniel Kahneman, we operate on a set of heuristics or mental "learning tools", which help construct the world around us. These heuristics assist in top-down processing in which the brain, acting as that reductive valve, points us in the direction of what is most relevant for our survival and well being. This top-down processing also explains why we might drown out irrelevant noises, or arrive at work totally unable to remember the details of the drive there. These cognitive processes that interpret reality are incredibly important in determining what to attend to and, ultimately, what information becomes part of our knowledge of the world.

These processes play a crucial role in language acquisition. In opposition to the long-accepted Chomskyan model of language development (known as nativism) in which an 'innate language module' exists in all humans from birth, a growing number of contemporary language specialists accept a usage-based theory of language acquisition (known as constructivism). In this model, championed by researchers such as Michael Tomasello and Paul Ibbotson, children use 'various types of thinking… not specific to language' in order to develop linguistic competency. These types of thinking are the same mental heuristics and top-down processes which reign in the wildness of reality.

So what does it actually take to learn a language? As mentioned before, Tomasello states that language acquisition requires a 'Swiss army knife' of cognitive capacities including pattern recognition, memory, attention, categorization, reading of communicative intentions and analogy making. Indeed, the task of acquiring language seems so monumental as to be almost magical, but it is simply the result of the brain's amazing ability to think, process and reason.

The first problem in language development involves the acoustics of speech. We need to parse a 'continuous stream of sounds' (into meaningful units, or phonemes according to researcher Patricia Kuhl. In acoustic analysis, there are no time intervals between words and the barriers between phonemes are undefined. From birth, babies are able to perceive all of the world's phonemes, but with exposure to a native language, they begin to only make distinctions between phonemes in their target language. The classic example is the 'r' and 'l' distinction which does not exist in Japanese. This means that, after about 12 months, Japanese babies will not perceive a difference between 'r' and 'l.' It is widely known that babies use statistical probabilities at a subconscious level to decide which sounds are important. This parsing ability is the result of 'perceptual narrowing' during brain development in which unnecessary neuronal connections are pruned.

This is the first obstacle to overcome for children with autism. This process of house-cleaning does not take place to the same degree in children with ASD, according to researchers Goumei Tang et al. Whereas a typically developing child might start to

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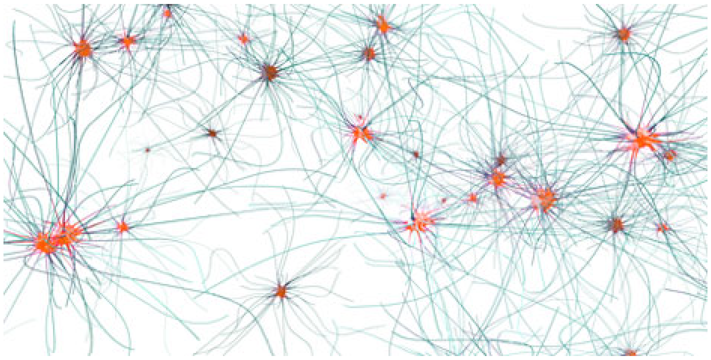

Image 3: Lack of neuronal pruning in childhood can lead to synesthesia in some individuals and also can create *increased auditory capacity.*

tune out the noisy crickets outside because the sounds are not relevant to her immediate surroundings, a child with autism might continue to process these sounds and direct her attention toward them. This makes the sensory landscape exceedingly difficult to parse and derive meaning from.

A poor signal-to-noise ratio, where background noise interferes with verbal communication can make learning speech and language exceedingly difficult -- particularly when assigning linguistic meaning to symbols (words) with very fuzzy phonemic boundaries. Of course, this difference in cognition is not such a clear good/bad dichotomy. Lack of neuronal pruning in childhood can lead to synesthesia in some individuals and also can create increased auditory capacity, according to researchers Anna Remington et al., including heightened pitch perception (e.g. perfect pitch). Despite its benefits, this lack of pruning poses a unique challenge to language development. (See image 3)

The second obstacle in language acquisition is the problem of semiotics. Semiotics is the study of assigning meaning to symbols. Any linguistic symbol that gets assigned a meaning becomes a unit of content in the target language. Not only does the overactive connectivity in the brains of children with ASD continue to play a role in compromising the formation of key connections between signs and symbols, but other factors also come into play. (See image 4)

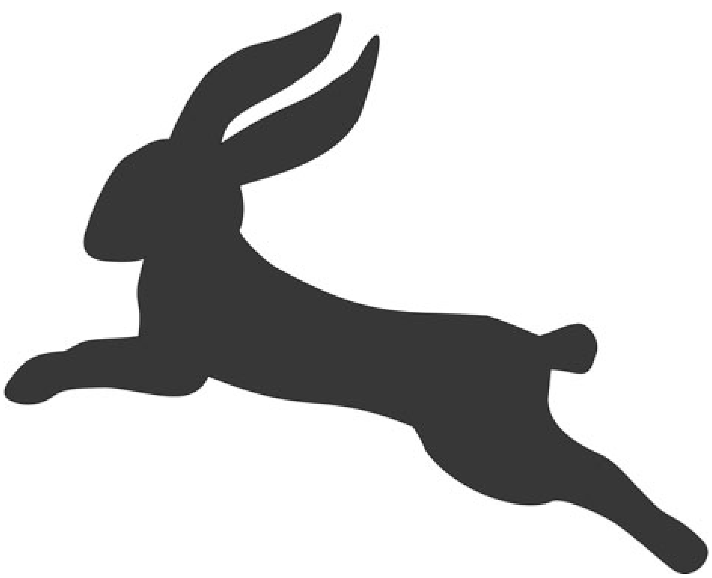

Image 4: The following is an explanation a semiotic moment using a classic language development thought experiment known as the *Gavagai Problem:*

The Gavagai problem describes a situation proposed by Willard Van Orman Quine in which a human is transported to another planet and discovers an alien pointing at a hopping object that looks like a rabbit. The alien says 'gavagai' while pointing at the creature in question. Most people would assume (and rightfully so) that 'gavagai' refers to the rabbit creature. However, Quine questions this assumption and asks why it might not refer to just the ears, the hopping motion, or something else entirely that the alien might've been thinking about. How does an infant's brain deal with all of these potential conflicts? It turns out our brains make a huge number of assumptions in order to constrain the near infinite possibilities of meaning. Amazingly, despite all of these possibilities, we are right most of the time!

Here's how the gavagai problem works in typically developing children. Imagine an infant interacting with the alien, how could the baby learn the meaning of the alien's word? The answer is through a specific learning tool called eye gaze triangulation. The infant triangulates gaze between the alien and the creature, looking at the creature then referencing the direction of the alien's eye gaze, thereby associating the spoken word gavagai with the target of the alien's eye gaze (the creature).

The child infers the alien's intention (i.e. communicating a label) and use joint attention to focus on the object in question. This resolves any guess that might just refer to the alien's private thoughts. The brain also uses a mental heuristic known as 'whole object bias' in which it assumes that a sign refers to the entire object rather than one of its parts. Over consistent use in similar contexts (either temporal, spatial or linguistic), children 'recognize' (either consciously or subconsciously) the usage pattern and acquire a functional unit of language.

Because differences in attention, sensory processing and social referencing compromise the ability to infer intention, use joint attention, and filter out distracting sensory stimuli in ASD, word-learning can become an effortful challenge.

The third problem is one of grammar, which involves morphology (word forms) and syntax (the order of words in phrases and sentences). The ability to string units of content together in a cohesive way is another remarkable achievement of human ingenuity. It turns out that we use several different methods for constructing the syntax of language. Two such methods are semantic and prosodic bootstrapping: in other words, using word meaning, stress and intonation patterns to figure out grammatical forms.

Based on both difficulties of assigning meaning to words, while using and understanding linguistic intonation patterns,

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Superheroes, puppies, hippos - and AI - are hleping children with disabilities bridge language gaps
YouTube: https://www.youtube.com/watch?v=n0ywmFO3Wzo

children with ASD face challenging obstacles during language development.

Language is our primary form of communication and, as such, requires groups to function. Sign and symbol relationships need to have meaning that stays consistent throughout the group so we can have a shared understanding of words. Language is the extraordinarily complicated tool that allows us to connect with each other, resolve conflict, and navigate nuanced social situations. Social connection is often thought of as an instinct in typically developing humans and is one of the primary motivations for developing such a difficult skill.

Yet children with autism often display inconsistent motivation to connect with others through social communicative conventions (e.g. language). Because of this, language for many children with autism may have less direct value for communication when compared to gestures, movements, vocalizations or other behaviors. If other motivating forces (hunger, thirst, etc.) don't require language to be fulfilled, words may not hold utility as a communication tool; it will most likely develop slowly if at all.

Of course, children with ASD are an incredibly diverse group of individuals, many with amazing strengths in some domains and hefty challenges in others. However, this new language paradigm definitely sheds some light on the reason for difficulties with regards to language development. The differences in a large number of the 'non-specific cognitive processes' involved in language-learning come together to form a perfect storm with regards to the acquisition of language for children with ASD. If this is true, this means that we should teach language to kids with autism differently. We should be especially in tune with what they will focus on and be motivated by in order to teach them the incredibly complicated sets of skills required to acquire language. Research has shown that technology-based interventions are an effective way to reach learners with autism. Now with the recent advances in artificial intelligence, there are some new options that could help people with autism acquire language skills.

ARTIFICIAL INTELLIGENCE

AI often uses sets of rules and processes to perform human-like cognitive tasks, and it's beginning to find its way into a variety of industries: automotive, healthcare, entertainment, finance, data security and manufacturing and the list continues to grow. Although AI has had an expanding presence in the commercial world, it has begun to emerge in other areas such as education.

In a recent Forbes 2019 article by Ron Schmelzer, called "AI

Applications in Education," the author discussed how AI will have a growing role for students and educators in the future. Schmelzer described a number of novel uses of educational AI:

- Hyperpersonalization: allowing users to customize how and when content is taught to them.
- Voice assistants: helping students navigate school websites, curricula, and assignments.
- Organization: assisting educators with non-educational tasks such as grading.

In essence, AI can help make teaching more efficient for educators while helping students learn more efficiently. Noticing the educational benefits of AI, InnerVoice's development team sought to integrate the technology into the app to tackle the challenge of language acquisition.

InnerVoice's Azure-sourced AI technology analyzes data, notices patterns and makes predictions from the patterns it perceives — in order to teach people with autism and other challenges how to communicate through language and emotions. However, InnerVoice also incorporates AI in the areas Schmelzer described:

- Hyperpersonalization and organization: using image recognition systems, InnerVoice's AI allows users to take pictures of objects in their environment and, within seconds, enters a label and a description onto a communication button, saving hours of time for parents, teachers and professionals who program communication devices.
- Voice assistants: InnerVoice's Chat Bot helps users practice speech intelligibility and communication skills by incorporating AI-based language-understanding technology.

Most importantly, InnerVoice's AI helps users learn foundational cognitive-linguistic skills associated with language acquisition such as joint attention, semiotics and symbolic communication. Joint attention occurs when two individuals collectively focus on an external object or event. During this framework, parents often look at something, label it with a word, and return their eye gaze to their child. This "eye gaze" triangulation allows parents to establish symbolic meaning to the words they say to their children. Symbols can be signs, written words or speech. All languages use symbols that hold meaning in large groups of people, words' meanings must stay consistent in order for people to understand each other.

Researchers Tomasello, Kruger, and Ratner (1993) stated that "Human linguistic symbols are socially learned, mainly by imitative learning in which the learner acquires not just the conventional form of the symbol, but also its conventional use in acts of communication (Tomasello, Kruger, and Ratner, 1993)."

Many children with autism struggle to learn words because they have difficulty establishing joint attention with another person; which can impact their ability to imitate key speech and language skills. However, research has shown that computer-mediated instruction is an effective way to teach children with autism a variety of skills. InnerVoice uses a medium that many people with and without autism pay attention to: mobile device screens. Using the mobile device's screen, its camera, image recognition AI and an animated avatar, InnerVoice can create a joint attentional framework, which can help teach language-based skills. (See image 5)

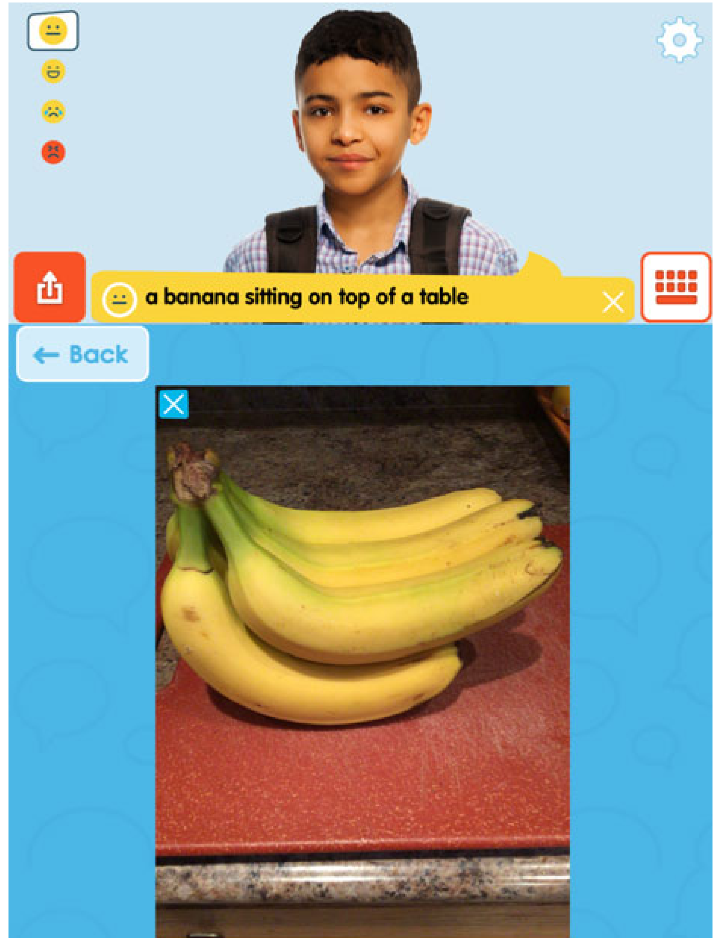

Image 5: The camera displays what you're looking at. Take a picture and watch InnerVoice's AI system label your picture with text and describe it with speech -- allowing users to see the relationships shared among the environment, speech, language, and text.

Here's how: the user looks at something, takes a picture of it, and the avatar on the device's screen verbally describes it while simultaneously displaying written text, allowing the user to pair the picture with written and spoken words: in essence, mimicking how people typically assign linguistic meaning to symbols through joint attentional frameworks.

InnerVoice's chatbot feature also helps with speech intelligibility and conversational skills. Users must articulate words clearly, or the chatbot will say that the user's message was misunderstood and encourage a communication repair such as "I'm sorry...could you please repeat that?" The chatbot also uses other conversational algorithms that encourage back-and-forth exchanges such as asking wh-questions (e.g. "What's your favorite color). (See image 6)

Juell Brandt, an administrator and teacher at Missouri's Cedar Ridge School for the Severely Disabled, said that InnerVoice

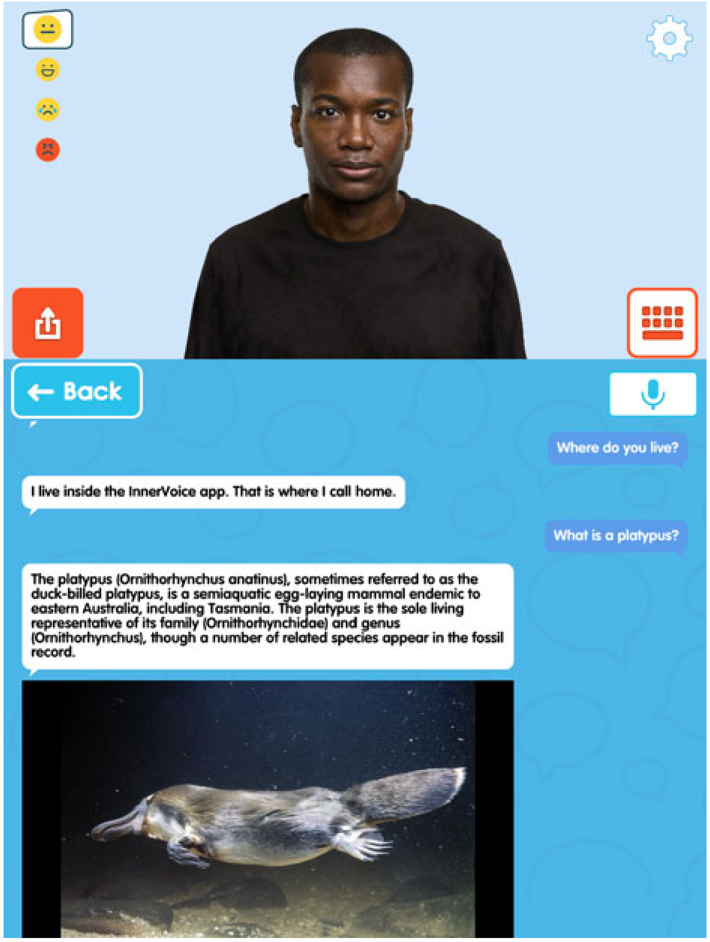

Image 6: Learning to ask wh-questions has never been more motivating! Choose an avatar from InnerVoice's library, use a photo of a face, or a favorite character, and watch them come alive in the app. Avatars move, emote and, most importantly, speak! Watching a face that the learner connects with helps increase imitation and engagement, and it's a lot of fun, too.

has helped students speak who were previously non-verbal. The Cedar Ridge teacher uses the app every day to ask her students about a variety of conversational topics such. The students also use InnerVoice to ask questions on field trips, such as when they conversed with the owner of a miniature horse farm.

"One of them didn't have any vocabulary when he got here at five, and now he speaks all the time," Brandt said about a student who uses InnerVoice. "Once we open the door for him he doesn't stop talking."

Despite the many exciting features AI currently offers, it is still in its infancy: not every object can be labeled correctly by image recognition, nor can a chatbot answer every question posed to it. Humans still reign superior in these areas. However, the technology is advancing exponentially and its uses for education may help millions of people learn to communicate through words and emotions.

Language is an extraordinary tool and, with it, we can speak life into infinity. Let's all work harder to cultivate the appropriate environments for all children to acquire the capacity for this uniquely human gift.

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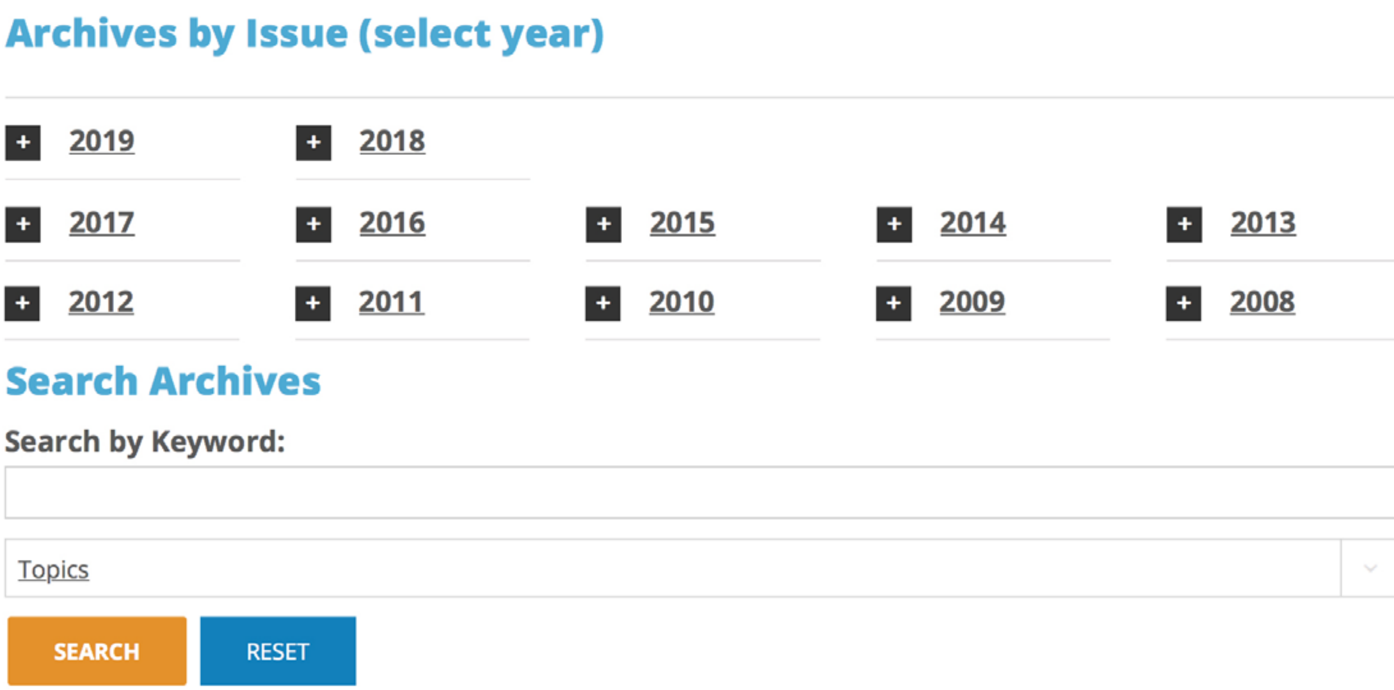
Solutions Membership as an eTextbook How They're Using it at the University of Nebraska at Kearney

In 2007, Donna J. Montgomery, Ph.D., Associate Professor, University of Nebraska at Kearney shared with the Closing The Gap community how she was implementing Solutions Memberships as required coursework for her Teacher of Education Master's candidates. Now, Camie West, Senior Lecturer, also at the University of Nebraska at Kearney, explains how she still uses Donna's framework, but has modified the assignments with her students. This article provides a full picture of their implementation model.

In 2006, a change influenced the way Donna Montgomery would teach her 'Overview of Assistive Technology' Course the following year. The course was to become available online. Prior to the course going online, she had used the traditional textbook model paired with demonstrations that introduced students to the categories of AT and then the specific hardware and software types within each. Moving into the digital course-offering, Donna felt that she needed to create an alternative, plus she wanted to provide a more active learning environment to her students. As a result, she dropped use of the textbook, created her own learning



Closing The Gap's Article Search Box

MARY JO BARRY, is a marketing consultant and a 20-year assistive technology professional. Currently Mary Jo heads up Closing The Gaps' membership development. Mary Jo has a Bachelor's in Education and has spent the majority of her career after teaching working as part of product development and marketing teams for companies producing products for people with varying disabilities. Ms. Barry is an author of curriculum, international speaker and trainer. Mary Jo works out of her home office near Phoenix, Arizona.

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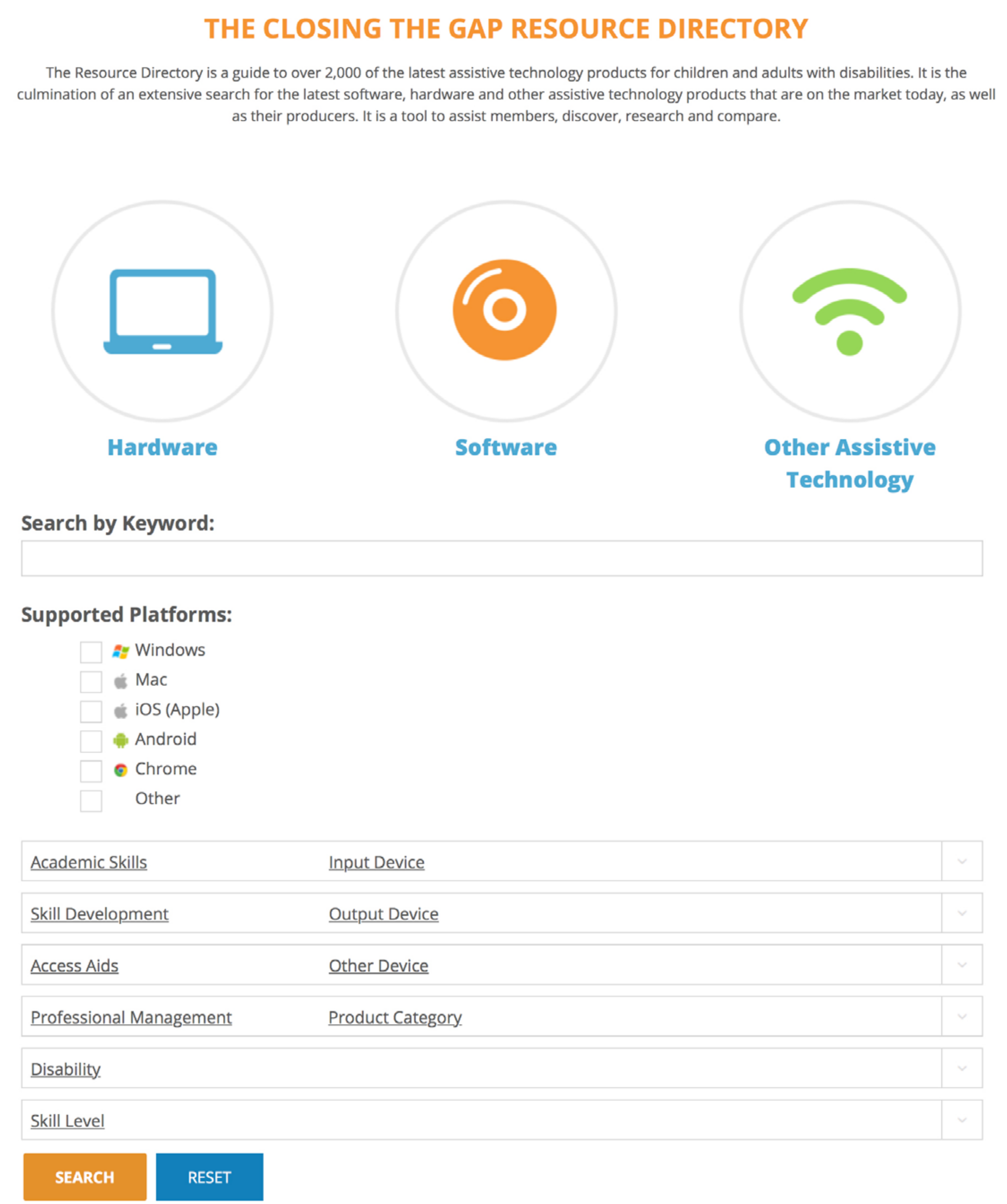

Closing The Gap's Resource Directory Search

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modules and prescribed Solutions Memberships to all of the students registered for her class. She found that students' response to the change was overwhelmingly positive and the course was highly successful. Here's exactly what she did:

The course is divided into fifteen modules, corresponding to the fifteen weeks of a semester. Students are expected to subscribe to Solutions during the first module. A PowerPoint presentation with screen shots of the Closing The Gap Web site introduces the students to Solutions. A Scavenger Hunt, assigned the first week, allows students to become familiar with the two features of Solutions. Questions vary from comparing the Closing The Gap Web site to searching for answers using the features. Throughout the semester, students use both the **Article Search** and the **Resource Directory** to complete assignments.

The **Article Search** is used to complete two different types of assignments. First, students are asked to find articles on a given topic, such as mathematics, and write an abstract. Students are given the freedom to choose an article that coincides with their present professional interests. Abstracts include a discussion of the benefits of the assistive technology (AT) discussed in the article and how the technology could be incorporated into their teaching. Students who are not teaching are asked to identify how they would incorporate the AT into their professional field.

The second type of assignment using the Article Search is to find and read a specific article dealing with the topic of the week. For instance, the ninth module deals with integrating the use of AT into the daily classroom routine. Students are asked to find an article about integrating assistive technology into the general curriculum. I give examples of articles by Hartsell et. al and 'Getting Assistive Technology into the Mainstream the EASY Way' by Sweeney. Students are asked to write a reflection. The reflection contains a discussion of the student's ability to conduct lessons integrating technology, and a brief description of how they could incorporate the technology/ideas into their professional setting.

FIGURE 1: Reading Case Study Example
Henry is an eighth grade male student who was diagnosed with a learning disability in Reading and Written Language in the third grade.
He is very dependent upon the Resource Room Teacher and Paraprofessional for assistance and reassurance that he has completed something correctly. All assignments and tests are read to him. Henry is functioning at the third grade level in Reading. He understands what is read to him and can answer questions equal to his peers. His tests in all subjects are read to him. His parents are concerned that oral testing will not be available to him in college and would like an alternative method of assessment explored. Henry loves to watch anything Science related on Discovery, National Geographic, Nova, etc. television stations. He does not like Social Studies, History, English or any subject taught in the traditional lecture format or anything that contains a great deal of book-reading. He has a tendency to daydream about Science, History or computers when he is in a class.

The **Resource Directory** is used in a variety of assignments as well. In scavenger hunts, first the students are given a list of AT devices and asked to use the Directory to read about the technology. Then they are asked to identify which of the devices might be appropriate for a given scenario. In case studies, students are given a description of an individual with disabilities who is struggling in an academic area. Students are asked to use the directory to find an appropriate software intervention that would assist the individual in the struggling area. Students must provide a rationale for their software choice. A sample scenario is provided in Figure 1.

The final exam for this course is a funding proposal. Students use the online **Resource Directory** to gather information to write a grant requesting funding for assistive technology that they can use in their professional setting. The grant proposal contains seven sections: summary, organization, problem description, work plan, impact, evaluation, and budget. Submission of the grant is not

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required, but many do submit it upon completion.

There are two goals for this overview course: 1) to expose students to the availability of assistive technology appropriate for all individuals, and 2) to incorporate assistive technology into the student's present realm of educational/instructional technology. Using Solutions allows students to meet both of these better than any textbook I have tried. Recently, students enrolled in the course this semester were asked to give midterm feedback on the course assignments. Students' responses included the following comments about Solutions which I feel summarize the impact Solutions has had on my students:

"Closing The Gap and Solutions have been the most helpful to me."
"Even though I have spent a lot of time on them, the Solutions assignments have helped with knowing what is available for students."

This year, we checked back with the University of Nebraska at Kearney and spoke with Senior Lecturer, Camie West to find what, if anything, has changed in the way she is implementing Solutions Memberships with students. Here's what Camie's doing:

The model has evolved with time—I've done a little updating. I now have the following modules:

1. General AT Information
2. Computer Access
3. Communication
4. Sensory Impairments
5. Academics
6. Acquisition/Integration

I have integrated **Archived Webinars, Archived Articles** (I also refer students to the current issue of **Solutions Magazine** in our discussion boards) and the **Resource Directory**.

Before we start the modules, I provide course information and an overview. In that beginning information, the students subscribe to Closing The Gap and complete an assignment to familiarize themselves with features of the website. It's called Solutions Scavenger Hunt (I change the questions a little each semester to more current content). See Figure 2

Figure 2: Solutions Scavenger Hunt – Camie West

(Please put all answers in your own words; do not copy and paste from the website or points will be deducted.) You are NOT required to write in complete sentences for this assignment.

Use the homepage and reference "About Closing The Gap" in the quick links provided at the bottom to answer the following questions.

1. Who are the founders of Closing The Gap?
2. What is Closing The Gap (in your own words)?

Click on membership at the top to answer the following questions.

3. What are the benefits of a standard membership subscription to Solutions?
4. Go to "Join Today" to go to the membership pricing page - What is the standard, single-user, 1 year subscription rate for non-student professionals?

Using the Solutions Sub-menu at the top of the Solutions Membership web pages, click on the appropriate links to answer the following questions.

5. Click on 'Current Issue'. How many Editorial features are in the current issue?
6. Archived articles go back to what year?

7. To search for an article by author, you will need to type in the author's name in the Search Archives box. Type in Joy Zabala, a well-known name in the world of AT.

- How many total articles did you find with this search?
- How many of those articles were authored or co-authored by Zabala (the rest she is referenced in)?

8. Click on "2016" and then "August/September". What is the title of the article written by Dave Tucker that appeared in this issue?
9. Click on the title of the article found in #8. What is one unique feature of this note taking software?

Go back to the Solutions Membership Options Page. Using the Solutions Sub-menu at the top of the Solutions Membership page, click on "Archived Webinars" to answer the following questions.

10. Searching the archives by date (you'll need to go back a few pages to get to 2017), what is the title of the February 23, 2017 webinar?
11. Under "search by keyword" click on the header labeled "topics". Select a topic-area from the list that grabs your attention and then click "search". Name one archived webinar that is available that matches your search results. (If there is not a currently archived webinar with your chosen topic(s), pick another topic.)

Scroll back up to the Sub-menus on Solutions Membership page and click on "Resource Directory" to answer the following questions.

12. In the Software area, click on 'math' under academic skills, 'vision' under disability, and 'secondary' under skill level. Click Search. How many pieces of software are listed?
13. Now select 'hardware' at the top and click on 'voice recognition under 'input device' and 'physical' under 'Disability'. Click Search. How many pieces of hardware are listed?
14. Click on "Other AT" at the top of the page. Under "Product Category" mark "seating/positioning/mobility" and under "Disability" mark "Physical". Name one item that is listed and the price range of that item.
15. Click on 'Producers'. What information is available with each of the listed producers?

We also have discussion boards in each of the modules. Many of the resources that they are using for the discussion boards are found through the articles and webinars of Closing The Gap. They also use the Resource Directory for an assignment where they search for devices that provide AT for individuals with hearing or vision impairments. In the last one, some of the items they looked at were magnifying options, closed captioning, Braille tablets, eSight, etc. And then there is one other assignment that involves hardware options for computer access such as a Tiny Mouse, Eyegaze Edge, Tecla Shield, KinderBoard, etc.

Lastly, in my updated model, instead of case studies, the students are divided into groups and they put together a resource for their classmates (groups include reading, writing, math, and executive functioning). Students create a project that has resources such as articles and programs/devices for their assigned area. They must address all ages (preschool through high school) in their resources. Once I have graded each group project, I share those resources with their classmates to provide a great resource tool for all of them.

I get a lot of good feedback from students about **Closing The Gap Solutions**, including students who have told me that their district was going to continue to pay the subscription to Solutions after course completion. Many of them have told me that they have shared Solutions as a resource with others in their district that were unaware that any such thing existed!

Thanks to both Donna Montgomery and Camie West for sharing the implementation process they're using in the University. Real-life examples of success and idea-sharing is foundational to the Closing The Gap Community and Solutions Members. How are you using Solutions Membership in your setting? We'd love you to share your successes with us! ■

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Using Technology to Support the Concepts and Principles of Applied Behavior Analysis Practices

The limited availability of professionals trained in applied behavior analysis (ABA) means these services are inaccessible to many communities (Wacker et al., 2013). ABA experts are frequently used to support diverse groups of students, including many students with disabilities. In an effort to extend the reach of behavior analysts there are many technology tools available to assist educators in implementing behavior analytic practices with fidelity. These technology tools are not easily identified by educators as the tools do not explicitly describe implementation. For example, teachers may not know how to use a technological tool to implement a behavioral intervention without support. This editorial provides a brief overview of some available technologies for educators and practitioners based in the evidence-based practices of ABA. This is not a list of technologies to replace behavior analytic expertise. These tools are not presented as tools to "implement ABA interventions" without additional support or training, instead these technologies are tools that can support and extend behavior analytic practices.

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SARAH HOWORTH Sarah K. Howorth is an assistant professor of special education in the School of Learning and Teaching, part of the University of Maine College of Education and Human Development. Her research interests include social skills and social coaching of individuals with autism, and the use of emerging technology such as virtual reality and augmented reality to support behavioral, academic and skills instruction for individuals with disabilities. She also has expertise in the following areas: assistive technology, reading comprehension, positive behavior interventions and supports, and improving employment and transition outcomes for individuals with autism and intellectual disabilities.
Sarah is a board-certified behavior analyst and has more than 20 years of experience in special education. She has taught as a classroom teacher in Michigan, Pennsylvania, New York, and Shanghai (China).ls.

ERIN FARRELL is a Board Certified Behavior Analyst and the Autism Spectrum Disorders Specialist at the Minnesota Department of Education. Erin is also an adjunct professor and doctoral student at the University of St. Thomas in Minnesota. Erin is studying the roles of behavior analysts in schools.

CARY TRUMP is an Assistant Professor at the University of Northern Colorado. After serving as a teacher in North Carolina, Dr. Trump obtained her Ph.D. at the University of Georgia, where she also consulted as a Board Certified Behavior Analyst. She is interested in applications of applied behavior analysis beyond tightly controlled settings.

INTRODUCTION

There is a rich research base to support the practices of professionals trained in applied behavior analysis (ABA) to support students with disabilities. Frequently behavior analysts support teachers in their implementation of behavior analytic practices to help support the needs of their students. A large evidence base exists demonstrating the critical ways technology can support and empower individuals with disabilities. This brief analysis explores some of the ways technology tools can support and extend behavior analytic interventions. There is a continued need to research and explore the most effective technology tools for practitioners to utilize in their practice. Many behavior analytic practitioners are looking for tools to support the evidence-based strategies that they utilize in their practice in school and clinical settings. As technology continues to change at a rapid pace we must continue to examine the most effective and accessible tools available for educators and practitioners.

As a means to connect the evidence-based practices to practitioners, we address some of the simplest technology supported strategies based in ABA that teachers and practitioners can utilize and implement immediately. We also address the need to connect evidence-based practices to new technology tools in the context of challenges for implementation.

IMPLEMENTATION CHALLENGES

There are significant challenges for equitable access to behavior analytic services. First, there is the challenge of inequitable access to services due to limited numbers of Board Certified Behavior Analysts (BCBA's) and trained behavior specialists, particularly those who provide in home services to families in rural states (Mello, Goldman, Urbano, & Hodapp, 2016). For example, Mello, Goldman, Urbano, and Hoddapp (2016) found that only 59.6% of the rural families they surveyed received behavioral services in their homes compared to 82.2% of non-rural families. Consequently, technological tools can help support the services provided to these families.

For practitioners in the field of ABA, the need for the use of technology to support their practice has grown rapidly. Practitioners are unable to easily turn to the research to examine specific technology tools or applications as the changes in technology far outpace the ability to conduct research in a timely manner. The ethical code for BCBAs indicate that BCBA's must rely on scientific knowledge when creating and implementing behavior analytic interventions (BACB, 2014). However, the development of technological tools far outpaces the research base demonstrating their effectiveness; therefore, behavior analysts must systematically evaluate the effect and impact of the technological tool on behavioral outcomes.

Behavior analysts also have a responsibility to advocate for the appropriate amount of supervision to meet behavior goals (BACB, 2014). Those ethical guidelines inform the current dilemma of the development of technological tools far outpacing the research base demonstrating their effectiveness. Technology can be an efficient tool to supervise practitioners' fidelity of implementation of behavioral interventions. Traditionally, when untrained educators attempt to implement behavioral interventions without being supervised by a BCBA, drifts in fidelity occur (procedural drift; Weiss, 2018).

CONNECTING

Practitioners utilizing the principles of ABA need access to support their practice in a wide array of applications. Likewise, practitioners trained in ABA use tools to support their practice in evidence-based strategies such as visual supports, data collection, implementation, supervising and coaching. The authors conducted focused training with practitioners to help them find and utilize apps and tools that support their practice implementing behavioral interventions. What follows is a description of how the technological tools identified help support their practice.

CONNECTING THESE TOOLS TO SPECIFIC ASPECTS OF ABA

DATA COLLECTION

One of the general concepts and principles of ABA is making data based decisions on what skills to teach, assessing and observing the skills an individual already knows, and which behavioral skills might be absent. Technology can save time when it comes to collecting these behavioral data and providing evidence indicating whether the student acquired and mastered the targeted skills. While these are commonly used by educators and behavior analysts it is important to remember that most of them can also be used to teach students to self-monitor their behavior.

Behavior Tracker Pro ($29.99/iOS) by Marz Consulting Inc. is a data collection app, specifically designed for students with Autism in mind. One of the greatest features of this tool is the fact that it allows for data to be collected for multiple students simultaneously. It is easily customizable to cater to each specific student as well in regard to what kind of behavior you are monitoring. There is an optional feature to save recordings that can later be used as visual documentation to present at IEP meetings to other staff/faculty and the students' guardians.

Catalyst Client (Free/iOS & Android) by DataFinch Technologies makes data collection mobile and easy to take anywhere you go. Rather than printing data collection, you can easily share your files with others via email or any other kind of downloaded file. You have the ability to monitor student progress in an organized fashion, such as the use of charts

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ABA apps		
Data Collection		
Tool	Cost / Platform	Description / Sample uses to support students with disabilities
Behavior Tracker Pro	$29.99/iOS by Marz Consulting Inc.	-caters to parents/educators who wish to monitor student progress -supports implemented behavior plans at school and in home -tracks and graphs ABC, frequency, duration, and interval data -export charts from device to email with phase change lines -optional video recorder to share with team members -customizable to cater to your specific student
Catalyst Client	Free/iOS and Android by DataFinch Technologies	-monitor student progress -data storage made easy -design graphs and other visual aids that display student's statistics -eliminates the need for entering data, printing data sheets and writing paragraphs -design the program you want to use for your student -flexibility of taking data with you multiple places with ease
Duration, an ABA Duration Recording App	$2.99 ($9.99 for the app bundle with Frequency, and Interval)/iOS by elocinSoft	-creates less work for teachers and their monitoring during meetings -allows more time for teachers to use their time with students directly -creates ease in re-typing recorded information post meeting -recording durations -send results to multiple platforms/file types -easy set-up for easier time utilizing the app's features
Tally – Counter & Dice App	Free/iOS by Lauren Allensmith	-records frequency of student's behavior -records duration of student's behavior -downloadable for Apple Watch

or graphs. In addition, this app helps diminish the need for heavy printing, manually entering data one by one, and writing lengthy paragraphs.

ABA Recording Apps ($9.99/iOS) by elocinSoft is a bundle of three ABA recording apps to support data collection. Intervals ABA, Duration ABA and Frequency ABA are three stand-alone apps that record exactly the kind of data that they say they do. This would be a good tool to help teachers, paraprofessionals and parents to record data in a clear and easy way on their mobile devices. These could be great tools for times when you want additional information like how frequently a target behavior is happening at home. You can use this with several students and track a variety of behaviors per student.

Tally - Counter and Dice app (Free/iOS) by Lauren Allensmith provides users with the option of not only recording the frequency of student's behavior, but also recording its duration. This can be important information for educators to have in addition to other variables that are important for students implementing ABA practices. With the collection of both frequency and duration data, it adds another factor to monitor student's progress. In addition to using this app on your iPhone or iPad, it does have an Apple Watch app download that can make duration incident recording even more accessible. The additional option to use an Apple Watch could help teachers quickly and subtly collect frequency data.

MODELING AND DISCRETE TRIAL

Another behavioral principle is that behavior is learned through imitation (Fritze, 2019). Technology can be used as a tool to model expected and unexpected behaviors and variations of what behaviors may look like in different scenarios (Sam, Cox, Savage, Waters, & Odon, 2019). Many apps across all learners are based on these principles of getting someone's attention, eliciting or modeling a behavior, and then providing a reinforcing consequence.

ABA apps		
Modeling		
Tool	Cost / Platform	Description / Sample uses to support students with disabilities
Model Me Going Places 2	Free/iOS by Model Me Kids	-great tool for students (children or teenagers) with Autism or IDD -social skill development practice -multiple locations (mall, doctors office, restaurant, etc.) that students may go and how to appropriately act in those given situations -appropriate behavior modeled by characters -navigation/easy to use platform for all students -audio narration available
ABA Flash Cards & Games - Emotion	$0.99/iOS by Alligator Aps	-teaches students how to recognize their emotions and the emotions of others -promotes social skills development -great tool for students with Autism or IDD -identify and appropriately respond to how others are feeling -personalize your own flash cards that cater to the child's life -game-based for student engagement
Functional Communication		
Proloquo2go	$124.99/iOS by Assistive Ware	-helps students who are nonverbal to have a voice -symbol-to-speech tool that students use to create sentences -create symbols that are represented in the student's lives -compatible with Apple Watch device
iCommunicate	$49.99/iOS by Grembe Apps	-customizable for creating storyboards, communication boards or flash cards. -assists students who are nonverbal -helps students appropriately and effectively communicate -twenty different language/accent options available
TouchChat	$149.99/iOS by Prentke Romich Co.	can be programmed in either English or Spanish -customizable vocabulary and pictures -additional feature: students can create stories and post them via iMessage or social media platform

ModelMeGoing Places (Free, iOS) by Model Me Kids models appropriate behavior in a variety of locations that students may go, such as the grocery store, the mall, or a restaurant, etc. This app provides options for students to practice their social skills within these situations. There is an option within the app for additional accessibility, such as audio narration.

ABAFlashCards -Emotions ($0.99/iOS) by Alligator Apps allows users to learn how to identify how others are feeling. Students with Autism or IDD may face challenges when understanding and/or reading other people's emotions in regard to body language and facial structure. This app allows customizable flash cards so students may see images and people they are familiar with. It creates a game-based, fun and interactive platform that helps students to remain engaged with the subject matter.

FUNCTIONAL COMMUNICATION

Digital tools are also available to help support communication behaviors such as asking for help, a break, or communicating various wants and needs with friends, teachers, and family members. When individuals are taught how these communi-

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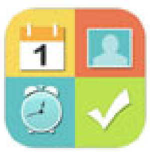
ABA apps		
Visual Schedules/Timer		
Tool	Cost / Platform	Description / Sample uses to support students with disabilities
Choiceworks 	$6.99/iOS by Bee Visual	-visual schedule -includes a timer -includes a choice board -makes transitions easier -makes routine predictable -helps students develop a sense of autonomy with choice
First Then Visual Schedule HD 	$14.99/iOS by Good Karma Applications	-can be used with students with ASD and other learners -can be used for students with Down Syndrome or Autism -can help students understand desired behavior in social situations -portable visual schedule on an iPad -choice boards -video models -social stories
Visual Schedule Planner 	$14.99/iOS by Good Karma Applications	-makes transitions easier -makes routines predictable -includes video support -can view daily, weekly or monthly -includes video modeling -timer -can input small schedules within the large schedule
Visual Timers by Utilities 	Free/iOS by Sinsoft	-makes transitions easier -helpful for students who struggle with staying on-task -brings visualization to time that can be helpful for students with Autism, learning disabilities, etc. -can set six timers at a time -can personalize each timer with a student's name -easy to use/customizable

cation behaviors, problematic behaviors are typically avoided (Carr & Durand, 1985). The following augmentative and assistive communication technology tools can assist in teaching these communication behaviors.

ProloQuo ($124.99/iOS) by Assistive Ware advocates for students to have their own voice. For students who are nonverbal, this tool adds a lot of value. Students are able to create sentences that are read aloud on the iPad or other mobile device, prompted by symbols and/or words to create sentences. The buttons that are available have been created by the publishers of the app, or you have the option to customize icons that resemble items or people in the student's life. This is a great tool for promoting student autonomy and individualism. This app is also compatible with the Apple Watch.

iCommunicate ($49.99/iOS) by Grembe Apps is a customizable app you can adjust to provide appropriate tools for individual needs. Some of the features of this app include designing storyboards, communication boards, flash cards, etc. that help students who are nonverbal learn to communicate appropriately and effectively. By pressing on icons or personalized pictures, students are given a voice to express their thoughts or needs at any moment. In addition, this app has twenty different language options and preferences.

TouchChat ($149.99/iOS) by Prentke Romich Company is specifically designed for individuals who have difficulty speaking. This app can either be programmed in English or Spanish, and allows for customizable vocabulary and pictures. The vocabulary is adjustable to meet the individual needs of the user and their current cognitive/reading level. There is even an option to help individuals create stories which they can then share via iMessage or any social media platform.

VISUAL SUPPORTS

Technology tools also exist that help to define and provide examples of schedules of reinforcement for teachers' aides, parents and behavioral technicians that keep track of how often positive or negative reinforcement is encountered. Visual sup-

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ports have been demonstrated as an evidence-based practice across the lifespan (Macdonald, Trembath, Ashburner, Costley & Keen, 2018).

Choiceworks ($6.99/iOS) by Bee Visual includes four different boards; schedule, waiting, feelings and feelings scale, this daily schedule app allows students or teachers to create their own visual schedules. The app provides a library of over 180 pictures/icons and allows the user to add their own photos, video, and audio recordings. Users can create an endless number of boards, as well as, print, or email the boards if need be. The app also has a child voice and adult voice to read aloud the items on the board.

First Then Visual Schedule ($14.99/iOS) by Good Karma Applications was created for caretakers, teachers or parents to help their students with completing a task analysis through a visual schedule. The users can add their own topics and steps in order to individualize it for each student. Voice recordings and user photos can be uploaded to personalize each visual schedule. Each schedule can be saved, shared and exported to a .pdf as well.

Visual Schedule Planner ($14.99/iOS) by Good Karma Applications is a wonderful visual tool that can help students view their daily schedule either daily, weekly or monthly. The visual aspect of having a calendar assists students with challenges in routine. It aids in making transitions both easier and predictable overall. One of the features includes video support, customized sound, a timer, etc.

Visual Timers (Free/iOS) by Sinsoft, Inc. is a visual time app that allows you to have six individual timers going at one time. You could use these as several preset timers for one student covering several behaviors or cover several students with a set of timers. This could be a good resource for helping students to self-monitor time on task for several behaviors.

CONCLUSION

These selections are just a small sample of the tools available to help support and extend the efforts to support ABA. This editorial provides a brief overview of some available technologies for educators and practitioners based in the evidence-based practices of ABA. This is not a list of technologies to replace behavior analytic expertise. These tools are not presented as tools to "implement ABA interventions" without additional support or training, instead these technologies are tools that can support and extend behavior analytic practices. These mobile apps provide ways that educators, therapists, families and individuals can use digital tools to support individual evidence-based practices.

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Providing Content Access while Teaching Braille Literacy

Neither the Georgia Department of Education, the Georgia Academy for the Blind, nor the State of Georgia operates or controls in any respect any information, products, materials or services that third parties may provide. Listing a particular product or posting of a link does not indicate Georgia Department of Education endorsement of that product or site. We encourage our users to research each product themselves and to read the privacy statements of each and every site they visit.

INTRODUCTION

Students who are blind use different media types to interact with print. These choices could be based on the content or the environment in which they are consumed. For example, one individual may use braille for technical content while also using auditory representation for pleasure reading.

Michael Yudin, Assistant Secretary for Special Education and Rehabilitative Services, in his 2013 keynote address to the National Library Service Braille Summit, sited a report from the National Federation of the Blind (NFB), Jernigan Institute, which stated that 90 percent of blind children in America are not learning to read braille (NLS, 2016). The problem of non-instruction of braille lead the United States Department of Education, Office of Special Education and Rehabilitative Services, to issue a "Dear Colleague Letter" reiterating the required instruction of braille when appropriate for children with disabilities (US Department of Education, 2013). Despite these numbers, the American Printing House for the Blind (APH) reported that during the 2015 census year, there were a total of 5,333 reported braille readers served by their program (American Printing House for the Blind, 2015). It's important to note that a reported braille reader in the census does not quantify the reader's literacy skills but only states the individual's primary reading medium.

A student who is blind typically begins to learn to read braille around the age of three. Teachers of the blind and visually impaired often use a combination of materials to build pre-literacy and literacy skills for students who are blind. Materials like Lots of Dots: Learning my ABC's (Pierce and Dougherty, 2003) facilitates braille character recognition through repetitive activities. Other instructional programs such as Building on Patterns (Pester, 2012) are designed to teach beginning braille readers all language arts areas of reading, writing and spelling. The latter is a sequential program with regular progress monitoring, unit "Check-ups" and assessments. Both are considered part of the Expanded Core Curriculum (ECC) designed to build skills needed to access the core academic curriculum for braille readers.

Decisions are made by Individual Education Program (IEP) teams based on recommendations for the use of braille as the student's primary reading medium. The IEP goals are written to address literacy training for the expanded core curriculum. However, IEP teams should also take into consideration alternative media types, i.e., auditory and/or text-to-speech that allow students to access the curriculum while they are gaining literacy skills in braille. There is no reading inventory that is exclusively designed to investigate alternative reading accommodations for braille readers and without alternative reading accommodations, students may not have full and independent access to curriculum content.

PRACTICAL APPLICATION

Reading abilities for students who are blind are often assessed using informal reading inventories. Instruments like these are important to establish instructional reading levels and

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can provide progress data on student achievement. These inventories and others such as a Functional Vison Learning Media Assessment (FVLMA) are effective in providing information on reading levels and selecting the appropriate media types for visually impaired students. This observational study was originally undertaken to investigate if the graded-leveled passages from the Protocols for Reading Accommodations (PAR) could be used with blind students to further provide information for IEP teams to make data-based decisions for the provision of accessible materials.

PAR was developed by Dr. Denise DeCoste and Linda Bastiani Wilson particularly for students with print disabilities associated with a learning disability or other specific neurologically based print impairments, such as dyslexia. PAR addresses student reading comprehension of grade-leveled narrative and expository text in three different conditions. The conditions are reading orally, listening to an adult reader and using text-to-speech. These conditions are repeated as needed at different levels to gather data on the extent different accommodations assist in increasing comprehension. Additionally, students are asked to rate the ease or preference of each condition using a Likert Scale.

PAR seemed to be a feasible tool to compare comprehension levels between media types after encountering many braille users who were typically two to three-years behind in reading for their grade. These students were still expected to access grade level materials although their abilities did not match the need. It is important to emphasize that the use of other media types, i.e., text-to-speech is not intended to supplant braille instruction but rather to provide access to curriculum standards if found to be a viable accommodation.

Permission to transcribe the PAR reading passages and associated materials into braille was obtained from Don Johnston and five students from the Georgia Academy for the Blind (GAB) were chosen to participate. Grade levels of students varied from 4th to 12th grade and all had at least a two-year gap between grade level and independent reading level. Independent reading levels for each student were determined from previously administered reading inventories.

Reading level scores were used to start the students at their independent reading level on the PAR reading passages. However, students were only given the opportunity to participate in PAR at their independent reading levels and embossed braille was substituted for print in the oral independent reading activity.

Reading comprehension in all three PAR conditions; independent reading, adult reader and text-to-speech are demonstrated in Figure 1. The highest comprehension at independent reading level was just above 80%. This student (Student 2) was the oldest in the group and therefore had more experience with braille. This experience with braille literacy could have contributed to the higher score. However, among the other students, it is impossible to speculate any possible relationship for their performance levels in any of the reading conditions.

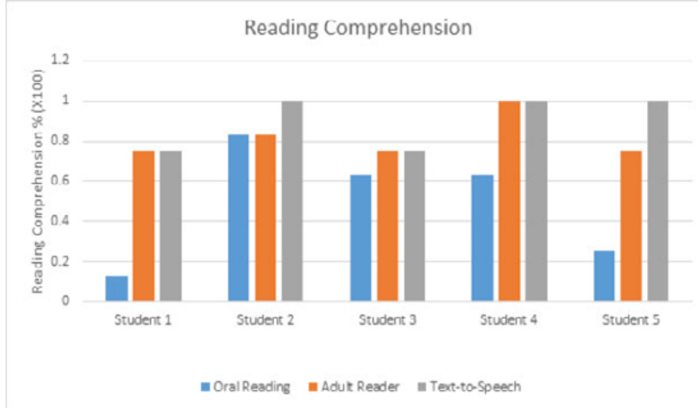

Figure 1: Reading comprehension scores in (percent) from students reading in three conditions of oral reading, adult reader and text-to speech.

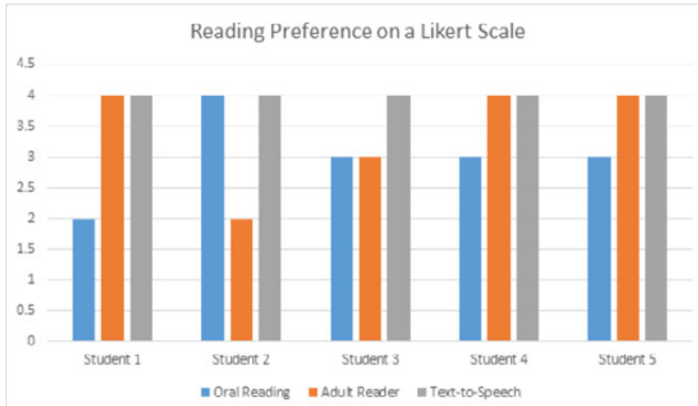

Figure 2: Reading preference as determined by student self-report from a Likert Scale in three conditions of oral reading, adult reader and text-to speech. Likert Scale values were 1-4 where 1 being the lowest preferred condition.

Given the data that all students performed at least equal to or better in the adult reader and text-to-speech conditions when compared to the independent reading condition could suggest that while students are continuing to develop literacy skills, other accommodations could be used to increase independence for access to the curriculum.

The data from the student reported condition preferences (Figure 2) is remarkable that all the students preferred being read to either by an adult or with the use of a text-to-speech software. It could be that the age of Student 2 was a contributing factor in reading preference being low on the adult reader condition but higher on the oral reading and text-to-speech conditions. This student was the only one for which the adult reader condition was far less preferred over either the oral reading condition or the text-to-speech condition. All other students preferred the adult reader or text-to-speech conditions when compared to the oral reading condition.

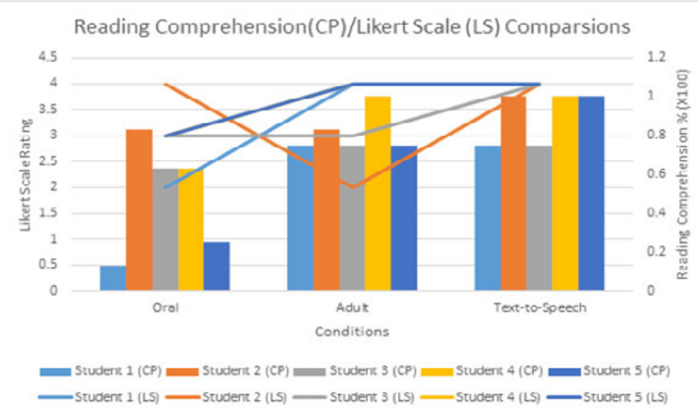

Figure 2: Reading preference as determined by student self-report from a Likert Scale in three conditions of oral reading, adult reader and text-to speech. Likert Scale values were 1-4 where 1 being the lowest preferred condition.

There was a direct pattern in the increase in comprehension scores and reading preference (Figure 3). In general, the Likert scale scores increased as the students' comprehension scores increased from the oral reading to the adult reader and then to the text-to-speech conditions. The observed trend could have been a result of the students feeling more confident about knowing the answers to the comprehension questions. It could also be that students were used to these additional supports in the classroom, although this was not determined at the time of the observation.

Development of student literacy should be the focus for educators of the blind. However, independent access to curriculum content should not be overlooked. To that end, if students have difficulty reading because of braille literacy skills other, IEP teams should consider different reading accommodations.

PAR in braille could be used to help direct IEP teams to recommend other accommodations and/or technology supports to allow students increased independent access to curricular materials. Additionally, IEP teams could use data from the PAR to help inform decision-making when considering accommodations for high stakes testing and the provision of classroom use of alternative accommodations. Having access to multiple representations of text (braille, auditory, and/or digital) can break down barriers that impede the learning and lead to student success.

Data collected in this observation is limited, however it provided a starting point for discussion on the applicability of using PAR with students who use braille as their primary mode of literacy and instruction. Further investigation should be undertaken to examine how PAR, administered in its entirety, can be used to help guide decision making for students who use braille as their primary access to print. The outcomes from this first implementation seem promising that PAR could provide information for IEP teams to make data-driven decisions for student reading accommodations.

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PRODUCTS:

Lots of Dots: Learning My ABC's, American Printing House for the Blind, $66.00

Building on Patterns, American Printing House for the Blind

Prekindergarten Student Kit, $859.00

Primary Braille Literacy Program Kindergarten, $209.00

Primary Braille Literacy Program First Grade Unit 1, $139.00

Primary Braille Literacy Program First Grade Unit 2, $139.00

Primary Braille Literacy Program First Grade Unit 3, $139.00

Primary Braille Literacy Program First Grade Unit 4, $139.00

Primary Braille Literacy Program Frist Grade Unit 5, $139.00

Primary Braille Literacy Program First Grade Unit 6, $139.00

Primary Braille Literacy Program First Grade Unit 7, $139.00

Primary Braille Literacy Program Second Grade Unit 1, $179.00

Primary Braille Literacy Program Second Grade Unit 2, $179.00

Primary Braille Literacy Program Second Grade Unit 3, $179.00

Primary Braille Literacy Program Second Grade Unit 4, $179.00

Primary Braille Literacy Program Second Grade Unit 5, $179.00

Primary Braille Literacy Program Second Grade Unit 6, $179.00

Primary Braille Literacy Program Second Grade Unit 7, $179.00

Protocols for Accommodations in Reading (PAR), Don Johnston, Inc, Hardcopy Free ■

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DISKoveries

Playing to Learn

As educators, we understand how important play is to learning. Here again is a collection of toys that have been selected because of their particular focus on language, communication, literacy, science and math, reasoning and thinking and creative play. Included are traditional (no screen) toys, battery run toys, smart toys with apps and toys that expand the use of the iPad or Android tablet in new ways, since all these kinds of play are now important to children's playing and learning.

My Little Farm (www.smartfelttoys.com)

MY LITTLE FARM (SMART FELT TOYS: WWW.SMARTFELTTOYS.COM)

My Little Farm is the second in the My Little World series of well-designed language learning tools from Smart Felt Toys. The original, My Little House, was reviewed in DISKoveries in the April-May 2019 issue of Closing The Gap Solutions e-magazine. Similar in design to the house, this barn and farm environment is a new kind of felt board that can be played with in many different ways: lying flat it's a four-panel, double sided felt board, and built-up, it's a three-dimensional farm and barn, again with two different views (a red barn and the meadows, hills, trees and sky of the farm). There are 32 felt pieces with pictures of animals, a farm family and farm related objects that can be used to enhance all aspects of receptive and expressive language skills, as well as social skills such as pretend play, cooperative play, independent play and so much more. The pieces were carefully chosen to provide this wide range of communication opportunities. Young children can match pieces to outlines, create their own stories and narratives using open farm spaces, compare, contrast, learn spatial and temporal vocabulary, etc. They can learn to follow directions, describe, request and to work on 'Wh' questions. The language learning opportunities are unlimited. Because of the clever design and Velcro on top and sides of the felt board, it is easy to switch between flat and 3D play. When finished playing, the whole board and all the pieces fold flat and fit into the box that has a handle on top for easy transport between rooms and houses. This is a fun and motivating toy for classroom use, for speech-language therapy and for home play as well. Created by Yvonne Johansen, a speech and language pathologist, the My Little World series is planning future titles including My Neighborhood, My Little Zoo, My Little Hospital and others.

To help reinforce early learning concepts associated with farm and animals, here are some related play opportunities:

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(e-mail: ForTLL@aol.com)

My Little Farm: YouTube Video Link:
https://www.youtube.com/watch?v=4dCiMoRdxPE

Apps: Toca Life: Farm, My Town:Farm, Dr. Panda Farm, Sago Mini Farm, and Duck Duck Moose-Old MacDonald Had a Farm. **YouTube videos:** Super Simple Songs: The Animals On The Farm, and Barefoot Books: Driving My Tractor. **Toys:** Sago Portable Playset: Robin's Farm Mini Farm (www.sagomini.com) and Fisher Price Farm (www.fisher-price.com)

Teachable Touchables Texture Squares
(www.educationalinsights.com)

TEACHABLE TOUCHABLES TEXTURE SQUARES (WWW.EDUCATIONALINSIGHTS.COM)

This sensory toy, for preschool ages, provides a fun, hands-on way for children to increase their awareness of the sense of touch, as well as building their descriptive vocabulary related to those textures. The toy includes 20 pillows and patches that measure approximately 2" by 3", each with a different texture (bumpy, furry, fuzzy, nubby, scratchy, slippery, silky, soft, etc.) and a drawstring bag to hold them all. Children can stack, sort and match them while becoming aware of their tactile sense. An included guide contains activities and suggestions for teachers.

Some touch and feel books that can help reinforce these early learning concepts related to the sense of touch and touch vocabulary are: **Pat The Bunny** (Dorothy Kunhardt & Golden Books); **Tickle,Tickle, Peter! A First Touch & Feel Book** (by Beatrix Potter- Penguin Random House); **Fuzzy Fuzzy Fuzzy** (Sandra Boynton); **Baby Touch & Feel Animals**, and **Baby Touch & Feel Farm** (DK Publishing)

Design & Drill (www.educationalinsights.com)

DESIGN & DRILL (WWW.EDUCATIONALINSIGHTS.COM)

Two new Design & Drill toys! Each set in the series contains a kid-friendly motorized drill with three drill bits (Phillips, socket and flathead), plastic bolts in five colors, activity cards and a full instruction guide. Children, three and up, match the design patterns by color or create their own. They match the heads of the bolts to the correct drill bits and away they go. They can create endlessly, unscrewing all and starting over again. Design & Drill toys helps children explore counting, colors, shapes and patterns while also building fine motor skills, eye-hand coordination, problem solving and creativity skills. Educational Insights does an excellent job in their enclosed manuals, explaining in detail how to sequentially introduce children to the tasks and concepts needed to use these games in a most appropriate and beneficial way. They help parents and teachers break down the tasks from simple to more difficult, from the motor, cognitive, visual and language viewpoints. Each new Design and Drill set presents variations that bring more skills, more and different kinds of creations and more fun and motivation.

Design & Drill See-Through Creative Workshop: This brand new Design & Drill contains a power drill, wrench and screwdriver, drill bits, bolts in five colors and activity cards. It has a see-through base so children can more easily follow the pattern as they drill directly into the base. Children first learn to match the bolts to the drill bits, use the screwdriver and wrench to screw the bolts in and remove them, and create their own designs. Then you can introduce a simple pattern card. With this new game, you can place the pattern card directly under the activity board and the children will be able to see right through the board, find the bolts, match the colors and then drill in the bolt. It's a great idea to help the younger users.

Design & Drill BrightWorks: This Design & Drill lets children make patterns that can light up and glow in the dark. Using the

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special translucent bolts, children can use two different light up modes. Using the 'On' mode, the board lights up (especially "cool" in a dark or dim room). In the Sound Activation Mode, the light in the board will react to sounds. As your child speaks or claps, the lights will light up. Turn on your favorite music and watch how the lights dance to the beat. Nice visual effects for all to enjoy! It's also a great way to show the very young that their voice can be an important communication tool.

Design & Drill: YouTube Video Link:
https://www.youtube.com/watch?v=YBuDwXm9_Ko

Code-a-pillar Twist (www.Fisher-Price.com)

CODE-A-PILLAR TWIST
(FISHER-PRICE: WWW.FISHER-PRICE.COM)

This is a new version of the original Code-a-pillar. Designed to be an introduction to coding for young children, it consists of a very cute caterpillar with five attached segments. Each of the five segments has a dial to twist- choose a green arrow facing up (for forward), an orange arrow facing left (for a left turn), a yellow arrow facing right (for a right turn), and either a musical note (for music), a paw print (for animal sounds), a leaf (for eating sounds), a speech bubble (for chat) or a moon (for sleeping sounds) or just twist randomly. The Code-a-pillar's head has a 'Go' button to start it on its journey. In a fun, errorless way, children begin to learn the meaning of the symbols they chose and their relationship to the path the code-a-pillar takes. Younger children start by turning the dials randomly, but as they get older, they understand that they can sequence moves through a process of coding. Using furniture and other barriers, they can create an obstacle course and then try to program their Code-a pillar to move through it. They learn to sequence the toy to go under, around, etc. by combining straight paths with right and left turns. For ages 3-6, this is a fun learning toy that offers new challenges as children learn and grow.

Code-a-Ppillar Twist: Video Link:
https://d2y5sgsy8bbmb8.cloudfront.net/36393301-ee24-451a-b429-01ace7a95770/default.jobtemplate.mp4.480.mp4

Code'n Learn Kinderbot (www.Fisher-Price.com)

CODE 'N LEARN KINDERBOT (FISHER-PRICE: WWW.FISHER-PRICE.COM)

Kinderbot is a colorful, smiling robot-like toy designed to introduce very young children to coding in a playful, errorless and screen-free manner. When started, Kinderbot's eyes light up, it plays music and does a little dance. It moves around on three wheels and has on the top of its head, four direction arrows (forward, backward, right and left) and a play and delete button. It also has three black buttons to signify each of the three levels of play.

On the easiest level, play is errorless - enter any sequence of code using the arrows and the robot speaks the direction as you enter each. Press play and it will move in those directions, again speaking the direction before it moves. It's a great way to help reinforce the learning of those directional words. In the second mode, Challenge Mode, Kinderbot asks children to enter a code with some specifics, for example, "use a code with exactly two moves", "use a code that only has turns", "code a path with exactly four moves", etc. Correct answers are met with music and a dance; incorrect responses with a "Not exactly. Let's try another." In the third mode, the Secret Code mode, Kinderbot guides the child to use the Secret Code book that is included. These codes direct Kinderbot to move in a circle, triangle, square, rectangle and others. The book also has directions for using the included objects (ramp, seesaw, wheel and others) for more complex movements.

Like other Fisher-Price toys, Kinderbot is well made, full of color, sounds and lights and turns off automatically if not being used. It provides feedback, many reward sequences and most importantly, it is designed to grow with the child and can be enjoyed by children of different ages, playing together, at home or at school.

Design & Drill: YouTube Video Link:
https://www.youtube.com/watch?v=Puhc17el1a0

Coding Critters (www.LearningResources.com)

CODING CRITTERS (WWW.LEARNINGRESOURCES.COM)

Designed for ages 4 and up, Coding Critters is a series of three screen-free STEM toys that provide lots of play opportunities while also teaching basic coding skills. The three coding games in the series are **Ranger and Zip** (a dog and its puppy), **Rumble & Bumble** (a dinosaur and its young baby), and **Scamper and Sneaker** (a cat and its kitten).

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Each of the sets features interactive pets (puppies, kittens or dinosaurs), a coding storybook and a collection of animal-related toy objects, such as a playhouse, slide, seesaw, a ball, a tree, some play food, etc. Each set has one battery operated Coding Critter that has four arrows (forward, reverse, right and left) and a 'Go' button on its back that is used to enter the coding commands. The coding critter also has a built-in speaker so it will make sounds like barks, meows and roars. Each has a baby animal on wheels to match for fun interactive pretend play.

The Coding Critter has two modes. In Play Mode, children can explore by pressing any button, the forward arrow to feed, the down arrow to send it on Patrol, the right arrow to Dance, the left arrow to have it take a Nap and the middle button to Pet it. This mode provides a fun opportunity for open-ended, errorless pretend play and also for exploration of the coding arrows. In Coding Mode, the four arrows will act as directional buttons (forward, reverse, left and right) and they can be programmed for simple to more complex moves.

The storybook in each set has a cute story about the animals and simple illustrated instructions to follow along with the story. For example, "Ranger's favorite toy is his green ball." (Use FORWARD commands to code Ranger to find his ball.) If you visit the website, you can also download printable storybooks, activity sheets and lesson plans. This is a toy that is easy to use for beginners and will continue to provide new challenges, as the children grow older.

Coding Critters: YouTube Video Link:
https://www.youtube.com/watch?v=DMCTAGdCIl4

DOLL PLAY AND MORE

Through the years, many toy and doll makers have begun to realize the importance to children of having dolls and toys that are like them and project their interests. We see dolls that are doctors, scientists, astronauts, soldiers and more but now we are also beginning to see female dolls in these positions and new dolls with disabilities. Here are some that are currently available:

MATTEL
(WWW.MATTEL.COM)

Mattel has a new **Barbie** in a wheelchair and a Barbie doll with a prosthetic leg.

AMERICAN GIRL
(WWW.AMERICANGIRL.COM)

American Girl has crutches, casts, wheelchairs, Diabetes care kits, service dogs and hearing aids for some of their dolls.

LAKESHORE LEARNING
(WWW.LAKESHORELEARNING.COM)

Lakeshore Learning as a series of multi-ethnic school dolls that have accessories available including: leg braces, forearm crutches, hearing aids, glasses, guide dogs, harness and canes, wheelchairs, walkers with accessory bags and protective helmets.

FLAGHOUSE
(WWW.FLAGHOUSE.COM)

Flaghouse has a collection of **Just Like Me** multi-ethnic dolls and doll accessories including hearing aids, glasses, dark vinyl glasses, guide dogs, canes, walkers, leg braces, forearm crutches and wheelchairs.

PLAYMOBIL
(WWW.PLAYMOBIL.COM)

PlayMobil as a figure in a wheelchair and a school bus with a ramp for the wheelchair. It also has a furnished children's hospital, an x-ray room and a female doctor.

BUILD A BEAR
(WWW.BUILDABEAR.COM)

Builld A Bear has wheelchairs, glasses, hearing aids and crutches for their bears.

MATTEL
(WWW.MATTEL.COM)

Mattel has also just released **Uno Braille** for visually impaired players.

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LEGO
(WWW.LEGO.COM)

Braille Bricks will be available soon. The Lego studs in this collection are rearranged to represent letters, numbers and symbols in an attempt to increase Braille literacy. Lego clearly recognizes the power of play for learning. In addition, Lego has begun to release building instructions in braille and via audio for visually impaired players.

Lego is also contributing to improving our environment by setting up a pilot program in the United States to recycle previously used bricks and donating them to nonprofit organizations. Consumers can print out a free UPS shipping label, pack their used Lego bricks in a cardboard box and mail them. The Legos will then get sorted, inspected and cleaned. Most will go to Teach for America, which will distribute them to classrooms throughout the country and to Boys & Girls Clubs of Boston.

HARRY POTTER HOGWARTS MYSTERY
(WWW.HARRYPOTTERHOGWARTSMYSTERY.COM/)

This new video game, for an iOS & Android, has added a character (Quidditch commentator and statistician Murphy McNully) who uses a wheelchair.

APPLE
(WWW.APPLE.COM)

In its recent new iOS 13 has Memoji, a personal emoji maker. You are now able to select ears with hearing aids. In addition, there are new emoji images of boys and girls in wheelchairs, using canes, wearing hearing aids and also service dogs.

Construct A Truck Dump Truck $ Jr. Engineer (www.mukikim.com)

MUKIKIM CONSTRUCT A TRUCK
(WWW.MUKIKIM.COM)

This dump truck is one in a group of four friction-powered construction trucks, designed by Mukikim. For ages five and up, it comes fully assembled, with a set of plastic tools, which include a plastic handle with interchangeable Philips and flathead screwdriver extensions, a wrench extension and a one-piece wrench with an easy to grip t-handle. In additional to traditional play (Rev it up and let it go!), this truck can be taken apart fully and then put back together again, challenging and rewarding play that encourages and develops reasoning and thinking, eye-hand coordination, fine-motor skills, spatial relations and language skills. There are 22 pieces to screw, unscrew, put in place, turn and tighten. It comes in four models, dump truck, excavator (36 pieces), crane (32 pieces) and mixer (25 pieces), all with two ways to play and battery free. For children having difficulty with taking the truck apart or putting it back together, make a step-by-step chart or sequential flash cards, identifying the next part, tool needed and action required. You can even take pictures with your iPad, record the directions and create a true-to-life sequence to follow. It makes an excellent activity to reinforce sequencing skills, following visual directions (pictures, symbols or words in print). It's also a great toy for both creative play and STEM learning.

If you were looking for a more advanced building toy, **Mukikim's Jr Engineer** would be the next step. This building toy is similar in concept to erector sets. Each of the two sets in the series contains parts, pieces, tools and step-by-step color-coded picture directions to complete two projects simultaneously (robot & airplane or car & helicopter). Children can also build custom projects using their imagination for additional creative fun. All pieces are lead-free, BPA-free, phthalate-free and washable.

Construct A Truck: YouTube Video Link:
https://www.youtube.com/watch?v=_mZpUFNphPg

Jr/ Engineer: YouTube Video Link:
https://www.youtube.com/watch?v=DoQ_309aQzQ

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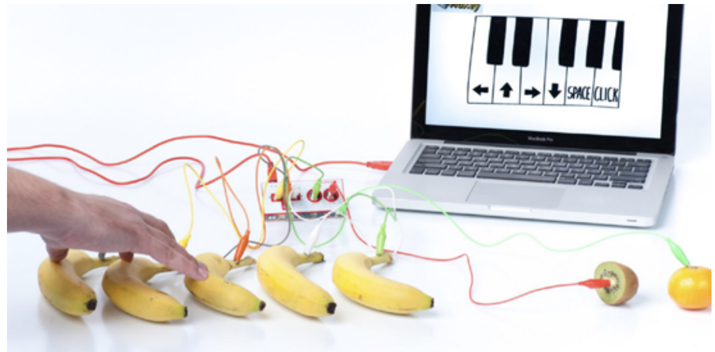
Rock and Roll It! Color CodeDrum Flexible Roll-Up Drum Kit (www.mukikim.com)

ROCK AND ROLL IT! COLOR CODEDRUM FLEXIBLE ROLL-UP DRUM KIT (MUKIKIM: WWW.MUKIKIM.COM)

This is an amazing musical instrument! Mukikim's Rock N Roll Drum Kit is made of silicone, and therefore flexible and able to be rolled up to put away or take somewhere. Using either a USB connection or battery power, the drum kit consists of symbol representations of a rainbow colored bass drum, tom-toms, a snare drum, floor Tom, crash cymbals, Hi-Hat and Ride Cymbals (10 percussion sounds), as well as floor pedals, and drum sticks. It can be used with headphones (included) or with external speakers (not included) and is Midi compatible. Ideal for beginners just taking an interest in drums, it has realistic and quality sound, and comes with an excellent booklet (which is also online) that shows the set-up, how to hold the sticks, how to read drum music, information about rhythm, time signatures, counting notes, using the pedals and more. There are 12 demo songs, nine rhythms to play along to, with record and playback functions. The Rock and Roll It! Instruments also come in a piano version. If you are a Music Therapist and are looking for functional instruments at a low price, try these first. Kids will love them and parents will appreciate them too!

Rock and Roll It! Color CodeDrum Flexible Roll-Up Drum Kit Video Link: https://www.youtube.com/watch?v=vPxqkA_asSE



Makey Makey (www.MakeyMakey.com)

MAKEY MAKEY (MAKEY MAKEY: WWW.MAKEYMAKEY.COM)

This is an invention kit that can be used to turn everyday objects into keyboard keys for your computer. It contains a Makey Makey computer board, alligator cables, wires and a USB cable. With step-by-step directions to follow, it's easy to connect and begin to use all sorts of objects to input to the computer. The basic keys are the four arrow keys, space and left click but you can assign additional keys (i.e. letters, numbers, etc.) by remapping them, (again just follow the directions). The enclosed manual has some suggestions to get you started: for example, a Fist Bump Remote control (fist bump will pause and start a video), a cardboard guitar game (pressing five quarters will play five different guitar keys), a veggie piano (five veggies will act like piano keys). Excellent for Assistive Technology. For example, you can assign letters to more easily accessible items (i.e. J-O-H-N) and make it possible for children who can't hit the keyboard keys to write their names. It's also an excellent science tool for creative thinking and problem solving. Visit the Makey Makey website to see the various sets available, for an introduction to inventing, for downloading apps for plug and play, for directions for a gigantic playable Makey Makey (for young children and for those with Special Needs), for sample lesson plans, for the Makey Makey blog and much more. See the video below to actually see the various objects and how they can access the computer. Visit YouTube for many more Makey Makey ideas.

Makey Makey YouTube Video Link: https://www.youtube.com/watch?v=rfQqh7iCcOU

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Octopus Watch V2 Motion Edition (www.heyjoy.io)

OCTOPUS WATCH V2 MOTION EDITION (OCTOPUS: WWW.HEYJOY.IO)

is an icon-based watch designed to teach good habits and time concepts to young children, age three and up. As a watch and scheduler, it links time to events through icons and helps teach independence and responsibility. The free app, available for Apple and Android in nine languages, is used to set up the daily schedule and has more than 2000 color icons that can be associated with tasks that you select. These icon notifications can also be accompanied by haptic feedback, which is experienced as a short vibration. The watch also comes with a night light-charging station that has a morning wake-up light and a night light with a tone that helps children fall asleep. A wireless connection turns on for only a few seconds when charging, to sync the watch. Other than that, the watch does not require a wireless connection. It does not emit sounds, is not a GPS tracker and is not a phone.

To see the time, children touch the circle on the bottom of the screen and the watch lights up, showing the display: there are options for the time in digital or analog form. If you press and hold the circle for three seconds, emergency information that you have entered (i.e., phone number, allergies, special conditions, etc.) will be revealed.

The real uniqueness of the watch is its ability to help the child learn to do tasks independently at pre-set times (i.e., 7A.M.-brush teeth, 6P.M, wash hands for dinner, etc.). At the given time, the watch will light up, show the time and icon of task, and deliver a short vibration. When the task is completed, the child presses the check and is given a visual reward. If the task isn't completed, the watch can deliver reminders once a minute for the number of minutes the parent choses. You can create different schedules for school days, weekends, vacation days, etc. In addition, you can select Motion Tracking, and the watch's motion sensor will measure the acceleration, duration and intensity of your child's movements through the day and reward them when they meet their daily goal.

To help with the carryover of skills involved in following this schedule, Octopus has created a visual scheduling system with magnetic icons. Using this set of 175 different symbols (three of each for a total of 525) on your refrigerator or any other similar surface, you can create and customize a visual schedule of your child's daily routine, as well as mini routine charts to help children remember what they need to do in other rooms in the house. If set up and used consistently, the Octopus can be an effective tool to assist the development of independence and organizational skills in young children.

Octopus Watch V2 Motion Edition YouTube Video Link: (https://www.youtube.com/watch?v=gJkITT1CkpA)

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Bluebee Pals Pro (www.bluebeepals.com)

BLUEBEE PALS PRO (KAYLE CONCEPTS: WWW.BLUEBEEPALS.COM)

Designed by Laura Jiencke, president of Kayle Concepts, Bluebee Pals are a collection of six plush, cuddly stuffed animals (lion, lamb, bear, zebra, puppy and monkey) that are also Bluetooth speakers that work with any Bluetooth enabled device and with all apps that have voice output. After pairing with phone, tablet or laptop, Bluebee's mouth and head move while it is "speaking" the words of the app. It can ask questions, reward successes, sing, read books aloud, and so much more. Bluebee Pals can also answer the phone –press the answer/end call button in the left ear. With head and mouth moving, the animal appears to be talking in the caller's voice. You can also use apps like Voice Memos, or Voice Recorder to have Bluebee speak a message - the day's class schedule, a birthday message, etc. Take a video of a Bluebee Pal speaking a greeting or message and email it to a friend.

The free Bluebee Pals Learning App contains some interactive learning activities and suggested fun activities with Bluebee, along with links to the website with app reviews for parents, teachers, Speech Therapists, Occupational Therapists and Music Therapists. The website also has tutorial videos, PDFs, resources and some printable worksheets. Fun toy with endless applications!

Bluebee Pals has a Special Needs Donation Program. Kayle Concepts donates Bluebee Pals to schools and organization across the country for use in classroom and therapy sessions. They want to make Bluebee Pals available to all to help encourage communication, language use, attention, sensory processing and positive behaviors. If you would like to participate in **The Bluebee Pal Project**, send an email to info@bluebeepals.com. Thanks, Bluebee Pals and Kayle Concepts, for these generous donations and for your commitment to children with Special Needs!

Bluebee Pals Pro YouTube Link:
https://www.youtube.com/watch?v=uHTeFM3c3no

EKid (www.ekidstudio.com)

EKID (WWW.EKIDSTUDIO.COM)

This is a free augmented reality app, for iOS and Android. Augmented Reality (or AR as it is frequently called) is when your camera merges a picture from your surroundings with a digital image from your device, adding elements to the real world, thus creating an "augmented reality".)

With this app, you print some free animal pictures, pick one and place it on the table and hold your iPad or tablet above the picture. As you watch, the animal in the picture appears to come alive. It will look like it is standing on top of the picture - it will be named, make sounds, move around, sit down, etc. You can even take a picture and save to your photos.

There is a Preview activity to see all the pictures, with animation and sounds, which are available for the app. There are a total of 96 pictures (animals and vehicles), hear them named, listen to the sounds they make and interact with the pictures (turn them around, upside down, make it move in another direction, etc.). Selecting Purchase will allow you to print six free pictures to use with the app. (90 additional pictures are available for in-app purchase.). Another free app, called **EKid Dinosaurs** is also available, with six free cartoon cards and six free real pictures to print. 60 other dinosaur pictures can be purchased and printed. If you prefer not to print your own pictures, you can purchase **E-Kid Studio AR Cards** which contain 96 3" square cardboard AR Flashcards. These are available from **Techterra Education** (www.techterraeducation.com). Full of fun and excitement, EKid with AR is a new and unique way for young children to explore, while learning and mastering vocabulary, language concepts and general information.

EKid YouTube Link:
https://www.youtube.com/watch?v=24ThN8JxcuA

Gameball (www.playimpossible.com)

GAMEBALL (PLAY IMPOSSIBLE: WWW.PLAYIMPOSSIBLE.COM)

Play Impossible has taken a classic toy and created a fun and challenging new way to play with it. Gameball is a 5.25" green or blue latex foam-covered rubber ball that connects via Bluetooth to an app from the Apple or Google store. It uses two AA batteries that charge in 20 seconds using a new rapid charging system and the enclosed "wand". The ball's technology includes accelerometers, a magnetometer, a Bluetooth chip, and a patented physics engine that analyzes data. The app remains connected with the Gameball, recording results from the ball's movements. It asks you to throw the ball in the air to an exact height, to shake the ball quickly for a period of time, to see how softly you can toss and catch, records when you drop the ball and more. When playing with a friend, it tells you who tosses the ball the highest, who can throw it the fastest, catch it the gentlest, shake it the most vigorously, or who can hold it absolutely still until a timer runs out. And that's just the beginning. The more challenges you succeed at, the more challenges you unlock. Play Impossible recommends the ball for ages 9-14, but many of the activities can be used successfully with younger children and older adults as well. There are games that stress physical play, eye-hand coordination, agility and creative thinking. There are activities like balancing the ball on the back of your fist as long as you can, keeping the Gameball in the air with taps, hits, volleys, without catching or dropping it, and much more. In addition, the company plans to add other activities. You can also navigate the app using the Gameball, double tap to make a selection, toss the ball straight up one or two-inches to advance through the game menu. There is a comprehensive manual online, along with a list of the Apple and Android devices the Gameball supports. This is a great toy for family game night and home play, but would also work well in a physical therapy setting and in classrooms.

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Gameball YouTube Link:
https://www.youtube.com/watch?v=2FwtsmAVm44

Specdrums (www.sphero.com)

SPECDRUMS (WWW.SPHERO.COM)

Specdrums will bring a whole new way to discover, play and enjoy music for individuals of all ages and abilities. Specdrums are accessible, app-enabled silicon rings with optical sensors embedded in them that play sounds, beats and loops just by tapping colors. Slip one or two on your index fingers and just tap anything, the enclosed multi-colored play pad (with the 12 different colors it recognizes), your clothes, toys, dishes, books or anything else. Jam alone or with friends. (The rings connect via Bluetooth and you can connect up to six Specdrum rings to one color mat.) Easy to use to just explore colors and sounds but with the potential for advanced music creation.

The sounds and music you create will play through the app on your mobile device (phone or tablet) either aloud or through connected earphones. There's a library of free sound sets to download or you can create and record your own. The eight base colors can be linked to single sounds of your choice and four additional colors can link to sounds that loop for a base track. Music created can be played back, saved or shared to Messages, Mail, iMovie, social networks, and more.

When used with young children, Specdrums may need to be supervised. The silicone is stretchy, so it can fit a small finger or a larger finger without difficulty. However, this means also that it can be bent out of shape or possibly split if not handled carefully. In addition, because they are small, care needs to be taken or they could be lost easily.

Specdrums can be an outstanding musical tool in special education and music therapy settings. They give users the opportunity to explore sounds and music in a fun, open-ended, exploratory manner. There is no right or wrong way to use them and they can produce individual creative music that can be shared with others.

Specdrums YouTube Link:
https://www.youtube.com/watch?v=3916TgLt2v8&t=17s

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MORE NEW WAYS TO PLAY AND LEARN WITH IPADS AND TABLETS

This section of the article includes playsets that expand the interactivity and learning capabilities of iPads and other tablets. It's always very exciting to see the new creative applications that keep appearing.

Osmo/Marbotic Little Genius Starter Kit (www.PlayOsmo.com)

OSMO/MARBOTIC LITTLE GENIUS STARTER KIT (WWW.PLAYOSMO.COM)

Another wonderful group of learning games, this time designed for ages three to five, from Osmo, partnered with Marbotic, two of our best designers of playsets for the iPad. The kit, for most iPad and Amazon Fire models (see www.playosmo.com/en/devices/ for a detailed list) includes an Osmo base and red reflector, four free apps and game equipment including silicone sticks and rings, costume pieces, a silicone mat and storage cases. The four games include the following: ABCs-build letters and objects with squishy colorful sticks and rings with help from a fun, animated character. Children learn letter names, letter sounds and how to copy simple configurations. Great for pre-readers and for those mastering letter recognition and identification and beginning sound-symbol association. It's also very helpful for those young learners who are having difficulty writing letters with a pencil or crayon. It provides them with an alternate way to form letters. The second game is Squiggle Magic, using the same sticks & rings. This time, the children create objects (i.e. a hat on a head, a fish, etc.) that then become animated on the screen. They unlock levels as they go along. The third game is Costume Party. Using the costume pieces, children experiment with the clothes and colors to make party outfits for the characters on screen. The final game, Stories, also uses the costume pieces, and children mix and match costumes to find silly solutions to obstacles and to navigate through the adventure stories. These games encourage problem solving and reasoning and thinking. Siblings and classmates will enjoy interactive play with these games, in addition to the independent play experiences.

Little Genius Starter Kit YouTube Link:
https://www.youtube.com/watch?v=2BxpiiMeZYY

Magic Phonics (www.marbotic.com)

MAGIC PHONICS (MARBOTIC-EDUCO- WWW.MARBOTIC.COM)

Magic Phonics is an educational set of 49 lower case wooden blocks that interact with iPads and Android tablets. They are used together with the Magic Phonics app, which is based upon a UK early literacy program. The app introduces letter/sound correspondences in a structured curriculum designed for Preschool and K-1. Using the wooden blocks, instead of writing, places the

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emphasis on hearing and practicing blending and segmentation, without requiring handwriting skills. Like Marbotic's excellent other products (**Smart Letters, Smart Numbers**, and the **Deluxe Learning Kit**, previously reviewed in DISKoveries in April 2019) the wooden blocks have different combinations of rubber sensors on the back that interact with the tablet so they can be identified. The blocks are 1.5 inches across, 2.25 inches long and .25 inch thick, and have a silver knob that is easy for little fingers to grasp and hold. They are electricity and battery free and do not require internet access to use. Each letter sound is introduced and taught following a step-by-step reading sequence. In addition, high frequency sight words are introduced and taught.

Four sounds/letters are introduced at a time (i.e. p-a-t-s; ch-sh-th-ng; oo-ar-or-ur; etc), children match letters, identify the sound the letter makes, identify beginning sounds, identify beginning sounds in pictures, identify ending sounds, use letters to build words, identify middle sounds, find the word that is different, all by stamping their blocks on specific spots. All words are illustrated with colorful graphics, and every time the sound is stamped, the sound is repeated. In both parts of the app, there are a combination of 18 learning sequences, with more than 150 words to discover and an additional 24 high frequency words to recognize. Children identify consonant letters/sounds, common letter combinations (ck, ff, ll, ss, etc), digraphs (ch, sh, th, etc.), and vowel combinations (ie. ai, ee, oi, etc.). There are also several review lessons with all sounds. Using this combination of letter blocks, a thorough and well designed app and the iPad/Android tablet, Marbotic has created an excellent, comprehensive and motivating early literacy program that develops phonemic awareness and sound symbol association, enhances vocabulary and helps to build reading and writing skills. Magic Phonics work with all iPads, except iPad 1 and with many Android tablets. (See the full list at https://www.marbotic.com/compatibility/)

Magic Phonics YouTube Link:
https://www.youtube.com/watch?v=zCyG9FeLpTA

Marbotic Sesame Street Numbers (www.marbotic.com)

SESAME STREET NUMBERS (MARBOTIC- WWW.MARBOTIC.COM) AND SESAME STREET (WWW.SESAMESTREET.ORG)

This new iPad playset features familiar Sesame Street characters and locations, 10 wooden numbers and 4 early learning number games. The app, downloaded from the Apple Store, is played on any iPad (except iPad original) with the included 10 wooden number stampers. Like the other outstanding Marbotic playsets, the wooden blocks have different combinations of rubber sensors on the back that interact with the tablet so they can be identified. They have a silver knob that is easy for little fingers to grasp and hold, and are electricity and battery free and do not require internet access to use. The 10 numbers are colorful and the Sesame Street character's eyes help guide new learners to understand their correct orientation.

A party is coming to Sesame Street and children, 3 and up, play number games to help them learn their 123s, counting and more. Players match and recognize numbers, and count objects, with Elmo; they pick out balloons with Big Bird, as they match, count and recognize quantity; they count food ingredients from the Food Truck with Cookie Monster and help Abby put up the decorations by counting and finding how many more she needs. All activities are well designed and offer supportive one-on-one counting. This playset and app are full of fun and learning for all preschoolers. (Available only at Apple and for iPads only).

Sesame Street Numbers YouTube Link:
https://www.youtube.com/watch?v=mOvV0KzDAw4

Smart Letters Lower CaseYouTube Link:
https://www.youtube.com/watch?time_continue=8&v=KfwNLbClj6c

Marbotic Smart Letters Lower Case (www.marbotic.com)

Marbotic Smart Letters Lower Case (Marbotic (www.Marbotic.com) This is a set of lower case letters that will work with all four of the Smart Letters apps- Bla Bla Box, Vocabubble, Lil Reader and Alphamonster. You can download separately or just download Alphmonster and you'll have access to all the others. If you have the original Smart Letters (Capital), you can now select which set you want to play with (capital or lower case) from the Settings. Great way to expand letter learning!

Shifu Plugo Link (www.playshifu.com)

SHIFU PLUGO LINK (SHIFU PLUGO: WWW.PLAYSHIFU.COM)

Shifu Plugo presents another new way to learn and play at the iPad and other tablets (see https://www.playshifu.com/plugo for list of tablets currently supported.). It is an Augmented Reality (AR) system that is designed to encourage exploratory play with block-like objects and to provide young children with emerging STEAM skills. PlugoLink uses 15 hexagon shaped magnetic blocks (each side is about .75" and the hexagon is about .25" thick). When you begin the game, you select the user's grade level (preschool to grade 8) so that the difficulty level can be adjusted accordingly. Once the initial set-up is done, internet access is not required. Plugo comes with a gamepad, which has a slot on top for the tablet and a magnetic play area on the bottom. Link has four different games with about 31 levels each and the goal is to build a stable structure to solve puzzles. Each time you place a link on the playmat or structure, it appears on screen. There is much guidance along the way, incorrect blocks are shown on screen with an X so you can quickly visualize them and correct. When the first structure appears on screen, for youngest children, a short riddle is spoken to help identify it. When competed, your structure onscreen turns into the object and animates. Older children get different kinds of guidance as they build. For example, at the 8th grade level, the design is shown for a given number of seconds and then is removed. Users can see the blocks they have built, and the x if the block is correct, but they need to remember the basic design. (Hints are available.) Blocks turn into pictures, or appear as pipes, gears and other things. There is feedback for every move that really is an assist to learning. This is an extremely well designed and well-thought out game, and highly recommended for children of all ages. Great family toy since children of different ages and levels can enjoy it together or independently. It's a great classroom toy as well and helps use iPads for interactive and co-operative play that encourages problem solving, visual spatial skills, and reasoning and thinking!

Shifu Plugo Link YouTube Link:
https://www.youtube.com/watch?v=zlf-BXx3LZk

Have fun playing and learning! ■

Wearable Electronic Magnifiers: Pros and Cons

Wearables have become a buzzword in assistive technology (AT) for people with a vision impairment, and most manufacturers in the field have introduced their own device into the market. This article seeks to cut through the hype surrounding these devices, and attempts to ascertain where wearables might offer benefits, and where they might be inferior to more traditional AT devices. Discover the current state of wearable electronic magnification technology, and what the future might hold!

In recent years there has been somewhat of an explosion in wearable electronic devices for people with a visual impairment, with several companies entering the fray with their own take on what a wearable low vision aid can be. In the consumer market there are wearable devices which have accessibility built in – the Apple Watch being a prime example, which has the same high-quality accessibility features you would find in the iPhone and iPad. In the assistive technology field, we find devices which have either been built from the ground up, or which have repurposed existing consumer technologies to create tools specific to people with vision loss.

Even within this specific market there is some variation in the type of devices available. The most prevalent type of device is known as a wearable electronic magnifier and is designed to be worn like a pair of glasses or goggles. These devices all work on the same basic principle; a camera is mounted on the front of the device and video screens are located on the inside. When a user places on the headset, they are looking directly into the video screens, and seeing a live feed from the camera. The user can manipulate this live image though various enhancements such as magnification, brightness and contrast and false colors. Devices may also offer other features, such as optical character recognition, video streaming, a photo mode and so on.

Other types of devices are also available and take a somewhat different approach. For example, Orcam (See image 1) is a finger-sized optical character recognition device which connects to the side of a pair of glasses, and can read aloud printed text, perform facial recognition, recognize colors and identify money. The Sunu Band is another interesting wearable which is worn on the wrist and provides haptic feedback to a user, aiding them in avoiding obstacles when ambulating. This category of

Image 1 – The Orcam has a lot of technology packed into a small footprint

LUKE SCRIVEN, is an assistive technology professional who has worked in the visual impairment field for the last 8 years. He holds a graduate degree in Assistive Technology Studies and Human Services from California State university, Northridge. Luke currently works at Vision Forward, a non-profit in Milwaukee, WI which seeks to empower, educate, and enhance the lives of individuals impacted by vision loss through all of life's transitions. He also creates content for Vision Forward's assistive technology YouTube Channel – find it at https://www.youtube.com/channel/UCXEVOemUjD2YESESlLzC0uA.

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device is not designed to enhance vision, but rather to provide sensory substitution for certain tasks.

For the remainder of this article, we will be considering wearable electronic magnification devices, as this is the fastest growing and most contested area of wearable devices for people with a visual impairment. Current devices include eSight, IrisVision, NuEyes, the Jordy, Cyber Eyez, Acesight, SeeBoost, the Patriot Viewpoint – and the list goes on! These devices are often found to be the most beneficial for people with central vision loss caused by diseases such as macular degeneration, whereby the use of magnification can reduce the relative size of the user's central scotoma (blind spot). Some devices also offer specific modes for users with peripheral vision loss caused by diseases such as retinitis pigmentosa and glaucoma. A visual acuity of at least 20/800 in one eye is usually recommended for best results.

One of the reasons that wearables have been popular with consumers is because they offer the promise of being useable for virtually any task. With the ability to focus both at near and in the distance, wearables have the potential to be beneficial for tasks including reading, writing, watching television, seeing people's faces, going to a concert, play or sporting event, seeing a lecture or presentation – the list goes on. The idea of one device that can perform all these functions is certainly appealing, offering potentially good value for money despite the generally high price tag of up to $6,000.

However, this is where we must show caution; just because a wearable has the potential to aid in these tasks, it doesn't mean that it is the best tool for the job. This can be particularly confusing for consumers, whose expectations are often high due to media exposure presenting a device as giving the blind sight. A message like this raises expectations that a device will solve all their vision-related problems, as well as suggesting that a device will give a person the same vision that they enjoyed before their vision loss. This is certainly not the case as, although a wearable might enable a user to achieve 20/20 vision, it is only achieved by using enhancements such as magnification which reduces a user's field of view and fundamentally changes the experience of seeing.

The visual field reduction caused by magnification is the key hurdle which users must overcome when learning to use a wearable device. The higher the level of magnification used, the smaller the field will become, and the less usable the vision will be. An obvious comparison is using binoculars, with the added challenge of a visual impairment. Additionally, as the device is mounted on the user's head, any movement of the head makes the image move also. This provides additional challenge in some key ways. The concept that the movement of the image is directly tied to the movement of the head can be confusing to some users, who comment that the image is 'jumping' when they move their head.

This is likely caused by the disorienting effect of viewing through a headset with a reduced field of view and magnification applied, which is compounded by the fact that the higher the magnification that is being used, the more and faster the image will move. Even when keeping the head still, involuntary natural head movements mean the image moves, which again is exacerbated at higher magnification levels. Getting used to smooth panning of the head then when looking around is key, and practice can help to reduce the involuntary head movements to a minimum. Training and practice are essential but are not indicated in much of the media surrounding headsets, which make it appear as if a user can put a headset on and instantly see 'normally'.

These challenges are the steepest when combined with wearables which have smaller screen sizes. Smaller screens are usually found in wearable devices which can be worn while walking, such as eSight, Acesight and SeeBoost, as it allows a user to retain their own natural peripheral vision while ambulating. This is an obvious benefit but does result in a device which is naturally harder to use for many people. Devices such as IrisVision cannot be worn while walking as they fully restrict a user's natural peripheral vision. The benefit however is that the screen size is much larger, resulting in a wider field of view (IrisVision claims a 70-degree field of view compared to a 34.5-degree field for eSight's for example) and usually a much more immediately beneficial improvement in functional vision.

Another challenge with certain head-borne electronic magnification devices is poor framerate, which leads to lag in the image the user looks at as they move their head. This can cause a sense of nausea, although often a user becomes acclimatized over time. However, when added to the challenges posed by a reduced field of view and involuntary head movements, a user with unrealistic expectations can often become disillusioned quickly when demoing a device, even if with some effort the device could offer many benefits to them.

This can be exacerbated even further if the main goal of the user is reading, which is oftentimes the case. While head-borne electronic magnifiers can focus at near distance and can certainly be effective for some people as a reading tool, the difficulties of usage already discussed are even more problematic at close distances where small and precise head movements are required. As such, it is often found that more traditional electronic magnification devices such as CCTVs (image 2) are preferable for reading. This is also often the case for writing, another commonly stated goal, particularly for seniors who might desire to write checks.

Another commonly desired goal of a potential wearable user is to use a computer more effectively. Unfortunately, computer use presents some of the same challenges as reading and writing, and is exacerbated by some unique challenges of its own. One of these is the image degradation caused when looking at a screen through a camera then through another screen. This can cause the computer screen to appear blurry irrespective of magnification, rendering it unusable. The low refresh rate of some

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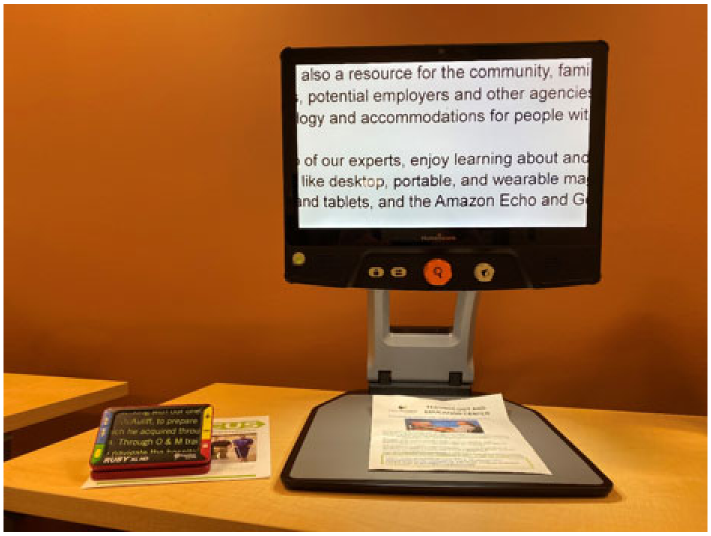

Image 2 – A handheld or desktop CCTV is an excellent solution for reading in many cases

Image 3 – eSight's design allows for light to enter around the headset

device's screens can exacerbate this issue even further. eSight has the best solution to this, offering an HDMI port to directly input the computer's output into the glasses. The image can then be magnified as needed and panned using inertial panning.

Another problem presented by computer use is the disconnect between moving the hand to control the mouse pointer, while moving the head to track the mouse pointer. This can pose quite a challenge when a user is at higher magnifications, due to the resultant reduction in visual field. Finally, the fully immersive design of some headsets such as IrisVision and NuEyes e2 completely eliminate a user's natural peripheral vision. This means a user who is not a touch typist has to continuously move their head up and down as they type, and adjust magnification as needed to see the keyboard and the screen. This can cause discomfort as well as be cognitively demanding.

Extended concentrated near tasks then can be problematic. Distance tasks however can be where wearable electronic magnification devices come into their own. Generally, targets that users seek to see in the distance are larger, and are therefore more forgiving of extraneous head movements even when taking into consideration that more magnification may be required to see them. A good example of this is television, a very common goal often only secondary to reading. It is very common for people to own televisions upward of 50" in size, with seating between 15 and 25 feet away. This already presents a good-sized target for a user to aim at, facilitating greater ease-of-use which is further aided by the relative lack of visual precision required to watch a lot of content, particularly with regards to programming featuring 'talking heads', game show style presentation and so on.

Of course, there are challenges inherent to other types of programming. One example is televised sports, which may feature a fast moving and small target. This could also be the case in action heavy television, and is certainly an issue when trying to read subtitles or the news ticker. Although there may be challenges in these areas, a user is often able to contextualize what they are seeing thanks to the audio output from the television, hopefully enabling them to fill in any visual gaps. As previously noted with regards to computers, looking at screens with wearable electronic magnifiers poses issues for the clarity of the image. This is usually not as vital in the case of watching television, due to the larger target size. One common issue however is contrast, with the television often looking washed out when looked at through the wearable. This can be easily adjusted either in the headset or using the television's controls, however this does require enough comfort with the technology to make the adjustments.

Other distance goals could include performing visual tasks outside, such as spotting street signs or identifying signs above stores. As previously mentioned, some wearable electronic magnifications are designed with ambulation in mind and are advertised as such. In order to achieve this, it is necessary that the device doesn't constrict a user's natural peripheral vision. This is because walking while looking into the device's screens is unsafe, as they do not provide a full and accurate representation of what is around a user. These devices then are not able to fully conform to the face (image 3), and as such allow ambient light from the environment to reflect from the device's screens, decreasing their visual legibility. Ironically, the wearables which cannot be worn while walking, such as IrisVision, work better outside (image 4) because their design prevents ambient light from reaching the screens, which retain their fidelity even in the brightest sunshine. However, as they cannot be worn while walking, a user is required to hold them up only when stood still and wishing to see something.

Neither design can be considered as entirely functional as a mobility aid, and certainly cannot be relied on as an alternative for users who already use aids such as a white cane. As such, wearable electronic magnifiers are best considered as addition-

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Image 4 – IrisVision's design blocks ambient light, but restricts peripheral vision

al tools in a user's toolbox, which might allow them to perform specific functions when outside. For example, IrisVision's design makes it a good device for watching sporting events, which are outside but seated, thereby mitigating issues with ambulation. eSight's design might be suitable for people who regularly travel to new places, as it can be worn while moving through busy airport terminals and used to spot departure signs.

Ultimately this is the best way to view wearables; they can be very good for specific tasks for specific users, another tool in the visual impairment community's toolbox but they don't represent a single tool that's best in every situation. From experience working with many clients in the past few years, sometimes a wearable can be a life-changing experience for a person, allowing them to do tasks they thought they had lost the ability to do in a somewhat naturalistic manner. Other times a client is disappointed, let down by the difference between what they had come to believe a wearable would do for them and the reality of its compromises.

In my experience, for people with central vision loss (macular degeneration is the primary disease amongst my clients) devices with larger screens and thus a larger field of view are superior for functional vision improvement. As such I have had very positive experiences with IrisVision, which was the first device to offer this immersive design. Ultimately though the person with the vision impairment must evaluate for themselves which device has the best ability to allow them to meet their goals, and as such it is recommended that they try as many wearable electronic magnifiers as possible before settling on something (or nothing!). One possible avenue of research people are able to use prior to trying devices is our InFocus YouTube Channel, where we have been creating an assistive technology video resource on wearables and other assistive technology devices.

We will close out on what the future of wearables might bring. There is obvious room for improvement in terms of physical appearance if nothing else. I would also suggest that plenty of improvements could also be made with the optics, as most, if not all, devices suffer from a reduction in image quality proportional to the level of magnification used. This is a result of the use of digital cameras, necessary to save space and weight, but not ideal for the task at hand. If manufacturers can achieve this then we may see wearables become the most popular assistive technology device for people with a visual impairment, and the explosion of device variety in recent years suggests that assistive technology manufacturers are interested in this being the case.

One interesting development worth keeping an eye on is Relumino from Samsung, a free app which can be downloaded on certain Samsung phones and which, in conjunction with a virtual reality headset, offers many of the vision enhancement features found in wearable electronic magnification devices. Even more intriguingly, they have shown electronic glasses designed to pair with the app which house a camera and screens, and which look just like a pair of sunglasses. A large company such as Samsung potentially entering the vision impairment market certainly could be a game-changer. It seems then that the future offers lots to look forward to!

REFERENCED PRODUCTS

Acesight. Manufacturer: Zoomax. Price: $4995. https://www.acesight.com/

Cyber Eyez. Manufacturer: Cyber Timez. Price: $2899. https://www.cybertimez.com/

eSight. Manufacturer: eSight. Price $5995. https://esighteyewear.com/

IrisVision. Manufacturer: Visionize, LLC. Price $2995. https://irisvision.com/

Jordy. Manufacturer: Enhanced Vision. Price $2500. https://www.enhancedvision.com/low-vision-product-line/jordy.html

NuEyes e2. Manufacturer: NuEyes. Price $2795. https://nueyes.com/

Patriot Viewpoint. Manufacturer: NE Low Vision. Price $2995.

https://nelowvision.com/product/patriot-viewpoint-glasses-96-degree-viewable-field/.

SeeBoost. Manufacturer: Evergaze LLC. Price $3499. https://www.seeboost.com/index.html

Sunu Band. Manufacturer: Sunu, Inc. Price: $299. https://www.sunu.com/en/index.html ■

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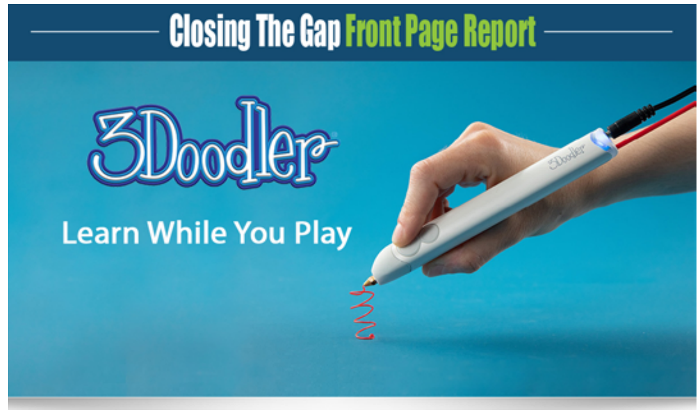

WHAT IS A 3D PEN?

A 3D pen is a pen that extrudes heated or warm plastic from the pen's nozzle. You don't need any software. There are no files to transfer, and no difficult tech to master. In the words of a teacher we work with, "whatever you imagine, you can draw. It goes from your brain, to your hand, right there."

With a 3D pen you can draw a raised graphic on a piece of paper or any flat surface. But what makes a 3D pen truly unique is its ability to "draw" in mid-air, allowing you to instantly form 3D structures right in front of you, which you can pick up and hold in your hand

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A NEW WORLD OF LEARNING

Floreo uses virtual reality to meaningfully impact individuals with Autism

Floreo is leveraging the power of Virtual Reality to develop a supplementary method of teaching social and communication skills for individuals with Autism Spectrum Disorder (ASD). Their library of lessons is fun and engaging for the learner, while also providing a supervising adult the opportunity to monitor and track the learner's progress. Floreo is currently being used by schools, therapy practices, and parents. Floreo's lessons are science-based; they are currently running several research studies including a study in collaboration with the Center for Autism Research at Children's Hospital of Philadelphia and National Institutes of Health.

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Outloud – With Their Apps You Can Make Speech Therapy More Effective and Fun!

WHO THEY ARE

Outloud is a Finnish app developer specializing in speech & hearing rehabilitation. Founded by a passionate speech therapist, they help you speak outloud!

THEIR HISTORY

Outloud Apps was founded by an SLP specialised in working with speech- and hearing-impaired toddlers. She has developed a visual timer and voice-activated gamified apps to make the sessions with her little patients more effective and fun and make the work of other therapists easier also.

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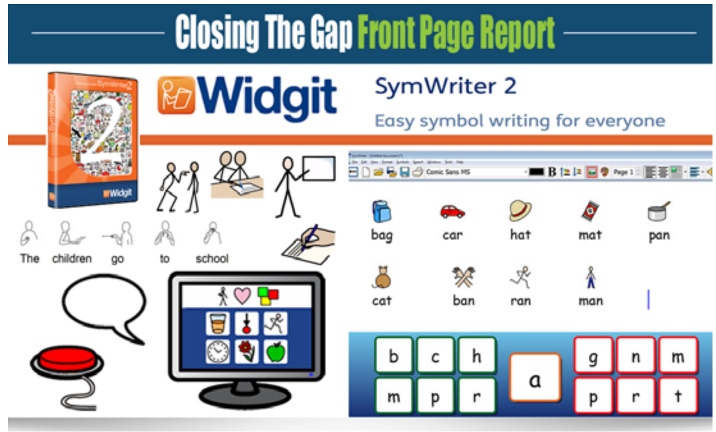
Widgit – SymWriter 2 – Easy Symbol Writing For Everyone



SymWriter 2 is a symbol-supported word processor that any writer, regardless of literacy levels, can use to create documents.

Writers of any age or ability can use theWidgit Symbols to see the meaning of wordsas they type, supporting access to new orchallenging vocabulary.

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