Assistive Technology Resources for Children and Adults with Disabilities

Closing The Gap

Solutions

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Volume 39 - Number 1

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See It, Do It, Imagine It The Power of Cause and Effect in Problem Solving

Conversations with my college roommate, before and after we graduated, turned out to be some of the most valuable experiences of my career. We talked for hours in our dorm room about our teaching philosophy and the rights of adults with disabilities. Many of these conversations were launched by our experiences working in adult group homes and by our special education professors who seemed to have glimpsed into the future, guided us along a path that was progressive and long-lasting - a formative thread as we began to teach students.

These conversations led me to pause and think before I pressed ahead with ideas in my classroom and in my current position in curriculum development. Although they took place with a growing contingency of special and general educators and support staff over the years, the topic has remained steady, beginning with 'What do we teach students with significant disabilities?' and evolving into 'How do we teach students with significant disabilities?' Later in my teaching career, the idea that learning depends on motor and language access was discussed in multiple conversations with the speech and language clinician and occupational therapist at my school. I knew it applied to my students despite their many challenges in those areas, sometimes alongside cortical vision impairments or hearing loss. The bottom line was I was getting paid to teach reading and math to my students regardless of their disabilities and challenges. My primary job was to figure out what that looked like for each student.

The concept of cause and effect came to mind last year as I was preparing Equals math training for teachers whose students have significant challenges with cognition, motor skills and language. My thoughts wandered around actions and outcomes as I was thinking about making the process of problem solving more concrete and immediately accessible.

As I searched the Internet for basic math concepts and problem solving that were viewed as manifestations of cause and effect, I found very little beyond causation and correlation. None of it was connected to basic problem solving in math. Why isn't there a clear focus on cause and effect in math class? After all, cause and effect is utilized in problem solving models by management gurus in the business world. It is very valuable in shaping our knowledge of how the world works and the basis for approaching a problem.

I began to think about typically developing students and their experiences. Then it hit me: cause and effect life experiences have been essentially inaccessible to students with significant disabilities. It is fantastic that software, computer interfaces, switches and adapted joysticks have been created to make computer use more accessible, but these are not always the optimal solution for a student with multiple challenges and do not replace hands-on experiences in the real, physical world.

Students without disabilities come to Kindergarten with a ton of real-life, hands-on moments from spontaneous play to instant creation when they grab whichever toys are handy. There isn't a barrier on the way to the table of Legos or motor skill challenges that prevent pushing plastic bricks together with a pincer grasp. They can begin to make something as soon as they think of it. Is it assumed that students come ready to learn, with the advan-

KAREN ROSS-BROWN has a BS degree in special education and MLS degree with an emphasis in assistive technology. She taught in special education for over 23 years in Minnesota and Wisconsin, specializing in teaching students with significant disabilities. Karen joined the curriculum team at AbleNet, Inc. in 2008. She was the primary author of Equals Mathematics curriculum and co-author of Equals Math curriculum revision (2017) with Jennifer Emanuele and James LaRocco. Karen has trained teachers in AbleNet curricula across the United States. She has presented at National Council of Teachers of Mathematics (NCTM) National and Regional Conferences, National Council for Exceptional Children (CEC) National Conferences, Closing the Gap (CTG) Conference, and Assistive Technology Association (ATIA) Conference.

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tage of countless cause and effect experiences needed to solve math problems? Students with significant disabilities may not have had those experiences. So, it makes sense to arm students with information about how our physical world works, whatever the impact may be.

Given that students with significant disabilities typically come to school with less free-flowing or independent exploration in their play, less access to use of toys and tools, and fewer hands-on experiences overall compared to same-age peers without disabilities, it makes sense to turn to the answer that lies within math itself: teach cause and effect that is present in math concepts and use of math tools in the process of problem solving. Using tools and strategies with learned, identified (and adapted) actions to solve problems makes problem solving more concrete.

Consider the concept of addition from the National Council of Teachers of Mathematics (NCTM) math content area Numbers and Operations, for example, which easily comes to mind when thinking about cause and effect: add two sets (cause) which results in one larger set (effect). All four operations are excellent examples of cause and effect, however, there are more examples from each remaining NCTM math content area:

Data Analysis and Probability: When you compile data and graph it (cause), a visual comparison is displayed (effect).

Geometry: Drawing two intersecting lines (cause) shows an angle (effect).

Measurement: Place a bag of apples on a dial scale (cause) and the pressure makes the needle move on the dial (effect).

Algebra: Write and multiply input amounts: 1, 2, 3 and 4 times 2 on an input/output table (cause) to reveal a pattern: 2, 4, 6 and 8 (effect).

By modeling and providing hands-on experiences with math tools and actions, students have firsthand views of cause and effect. With access to language, students can talk about what happened. This, in turn, can be used when problem solving. When students are familiar with an action and its effect, they are more likely to choose that action when it makes sense in solving a particular problem. For example, if I know adding means to join two sets together for a total, I will think of it when I solve a problem with two sets that are put together.

Teachers must make cause and effect experiences accessible for students with disabilities by modeling and adapting actions with math tools and materials so students can understand and have as much hands-on experience and independence as possible. With access to language, students can then talk about what is happening or what has happened right in front of them. These ideas fit nicely with the math community's persistence that hands-on math is very valuable, especially when paired with models, exploration, and discussion. For students with disabilities, there are steps to take to provide access so they, too, can watch, do and talk about it, specifically with concrete objects and actions that make clear what is happening. Here are basic first steps in that process: 1) make sure students are receiving instruction that covers and connects basic foundational math skills, 2) build cause and effect background knowledge with models and exploration opportunities using math tools and strategies present in the lesson, 3) support problem solving with concrete objects, 4) show concrete objects and lesson materials in two or three choices as a way for students to communicate, 5) expand cause and effect by asking questions with well-planned choices and 6) support students' collaboration and risk-taking by accepting each answer to a question, then check and discuss.

1. **Make sure students are receiving instruction that covers and connects basic foundational math skills** by providing math curriculum that is connected meaningfully across all math content areas, such as those recommended by the NCTM: Numbers and Operations, Geometry, Algebra, Data and Probability and Measurement. (It is worth noting that other sources, such as Common Core State Standards, show different configurations of content areas. However, the same math content is covered in each source, just sorted differently.) Typically, the idea of connected math across all math content areas has been ignored in traditional special education math programs, especially those described as functional math. When you consider that we all learn by connecting new information to relevant known information, the idea of pre-requisite skills becomes monumentally important. As we learned from Equals math curriculum data, students with disabilities learn very well with general education math instruction methodologies that are based on brain and learning research, including making connections in learning, as long as access, appropriate pacing and adaptations are provided. When you think about it, isn't teaching math connected within and between all math content areas an example of promoting generalization that we have embraced as proof of a learned concept? Why, then, have we been teaching in functional math silos for so long, with limited scope in math content and no connections between concepts?

In talking with many educators over the years across the United States, I found that the principles of math instruction neglected in pre-service teacher education tend to play a role in teachers clinging to long-held, ineffective practices in math. Essentially, students with moderate or significant disabilities have been left without quality math instruction altogether, resulting in special education teachers improvising. Unless teachers have had some background in curriculum or the good fortune to be handed an appropriate curriculum for their students, they wouldn't have necessarily known what was missing.

Now that we know what is missing, it is essential to look for a math curriculum that is robust, connected and complete, deftly utilizing quality math instruction based on best practice principles of learning and brain research with access that is necessary for optimal engagement and understanding.

2. **Build cause and effect background knowledge with models and exploration opportunities using math tools and strategies present in the lesson** prior to problem solving. This is a must in good instruction and should be part of the math curriculum itself. Background knowledge, with an eye towards cause and effect, must include structure for students to rely on, such as familiar vocabulary, a related game, and concepts brought forward from past lessons. Modeled use of tools and strategies paired with math concepts and action words, e.g. add, place, sort, etc. help students see what is happening. When they have access to those same materials to explore, they can experience cause and effect firsthand. In Equals math, the Action Dictionary provides access by way of multiple adaptation suggestions for each action present in the lessons. Teachers choose which adaptation works best for a student and tweaks it to fit, or perhaps comes up with a new idea inspired by the adaptation ideas. Whichever is chosen, the idea is to basically provide enough support so students are able to watch, do and talk about what is happening as independently as possible. It may be necessary to show explicitly what the problem or the cause and effect relationship is about so students know what you are talking about, even if it feels like you are 'giving away the answer'. It doesn't matter, however, because if a student doesn't know what you are getting at, wildly guessing the answer has no significance or merit.

3. **Support problem solving with concrete objects.** Through the process of problem solving, we usually think about several things, in varied order, such as naming the facts in the problem, choosing an action to take, identifying what the outcome might look like and which tool and strategy to use. Students with significant disabilities typically require concrete materials for understanding this way of thinking, one step at a time. (This is not to say that students with significant disabilities never see semi-concrete and abstract representation. They require exposure to these as well, since numerals, operations symbols, pictures and X's on a graph or array are a part of our world). Problem solving in a story format makes good sense for its relationship to the real world. However, the story can become a barrier when trying to navigate a math problem buried in a ton of words. This is where concrete objects cut through to the essence and increase interest as well. Well-placed objects fastened to the problem above matching key words can assist students in focusing on the facts. Reducing the language down to basic facts and concepts of the problem is also helpful as long as math terms are maintained and the essence of the problem is preserved. When it comes to math terms, concrete representations of vocabulary, as seen in Equals math, support the meaning in the problem.

The pic-symbol supported and demonstrated action words embedded in Equals lessons as background knowledge re-emerge when students are asked, "What do you do?" to solve the problem. Making an estimate about an amount or a prediction of an outcome can be shown in a display of possible outcomes as depicted by objects. For example, in a problem adding three insects and two insects, I can ask my students to estimate how many total insects there will be when I add them, giving three choices displayed with insect counters: two insects, six insects or one insect. The students can estimate, comparing the insect sets of three and two attached to the problem to the three choices in the display. When solving a problem, students are asked to choose a tool or strategy. Often, the strategy can be linked to a tool or counter so the question has concrete answer choices. Using tools/strategies that were previously explored is key. In Equals math, you will find problem solving hinges on a well-planned exploration of background concepts, vocabulary and lesson objects and materials that are carried into the problem-solving process. Choosing a tool and strategy, then, is easy to provide as the students already have had experience with them in the beginning of the lesson.

4. **Show concrete objects and lesson materials in two or three choices** to narrow the field after asking a question or expecting students to comment. Providing choices for students who do not have access to a communication device programmed to represent what is happening in math at the moment is a necessary support. Of course, students need access to their own communication systems at all times. However, in math class, students also need to have relevant choices to answer questions about the problem at hand. Providing two or three choices will give students power in the process while limiting the scope of possibilities from all the math tools in the world to just the math tools on the table. It gives the student a chance to focus on and use familiar objects that were explored earlier in the lesson to answer a new question. Students have access to a display by eye gaze, point or touch. If a student requires a different response, recording "That's the one I want," on a Step-by-Step communicator, placing it near the student, and pointing to each choice works well.

5. **Expand cause and effect by asking questions with well-planned choices.**

By expanding on questions about the lesson concept and what happened in the problem, students have an opportunity to engage in basic reasoning with materials they know. For example, students learned about using three dimensional shapes (cubes) to make a new three-dimensional shape (rectangular prism tower). Three objects are placed in a display: a butterfly counter, a cube and a hexagon with piles of each object on the table nearby. The teacher asks, "What do you use to make a tower?" When a student chooses, the teacher follows through and demonstrates building a tower with the chosen object, asking students to assist or build it themselves (with adaptations to support students building a tower as needed). Discuss what

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happened, e.g. Did stacking the butterflies make a standing tower? What happened? Repeat with the remaining choices and vote on the one that worked best. This type of activity increases opportunities to observe and/or experience cause and effect with different materials, resulting in a simple discussion about what works well and what does not.

6. **Support students' collaboration and risk-taking by accepting each answer to questions, then check and discuss.** Whether asking a question during a lesson or when expanding cause and effect, students should be given the opportunity to make a choice and follow through with it. Not only do they experience the cause and effect of their choice, it opens up students' thought processes to try new things and make comments without fear of judgment. It's wise in these instances to sidestep the idea of right and wrong answers, and instead vote for the most likely solution that will solve the problem. Decide as a group which choice works best or whether or not the problem is solved accurately.

There are many benefits for students with significant disabilities when solving problems with a focus on cause and effect using concrete materials. Opportunities for language use increase in a small group when students have a way to talk about what is happening in the moment during math class. Students expand their language when they use and understand math vocabulary, tool names and action names. Research has shown that communicating about a math concept increases achievement. Additionally, making choices is a staple of language access for any purpose. We all make choices when we speak, whether it occurs using a verbal voice or a communication system. Also, working and communicating in an interactive, collaborative group as a valued member satisfies the need for belonging within a supportive atmosphere.

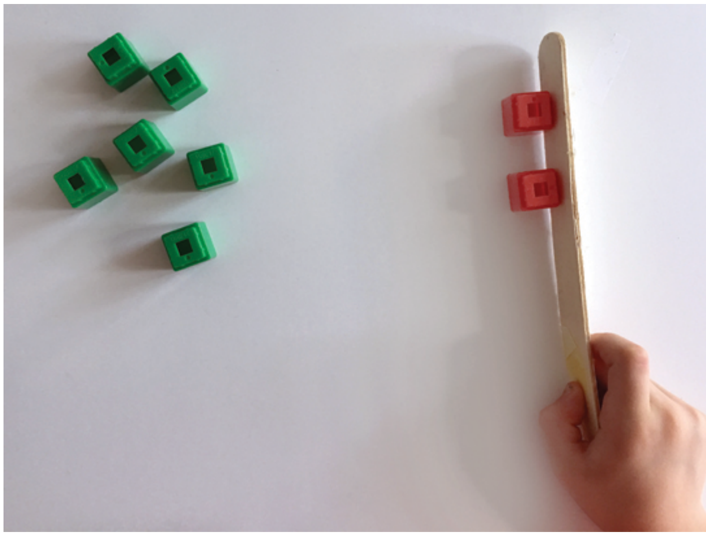
Viewing and engaging in cause and effect activities is a practical and concrete way to see how the world works. Use of the tools in making choices bring students into the here and now to directly connect with the task at hand. Becoming familiar with the function of math tools is useful, making it more likely the appropriate tool for a specific problem will be chosen now and in the future.

Students can experience and begin to understand the power of making a choice, completing an action, and observing the outcome, especially when adaptations are made for the student to act with more independence. There is value in setting up students for success by offering ways for them to observe and engage in thinking about cause and effect, using concrete objects, seeing how it all plays out right in front of them and talking about it, which brings together cognition, motor skills and language in a learning environment. This kind of learning puts students with significant disabilities on track for reaching their potential, whatever that might be.

EQUALS MATH ACTION DICTIONARY - SAMPLE ADAPTATIONS

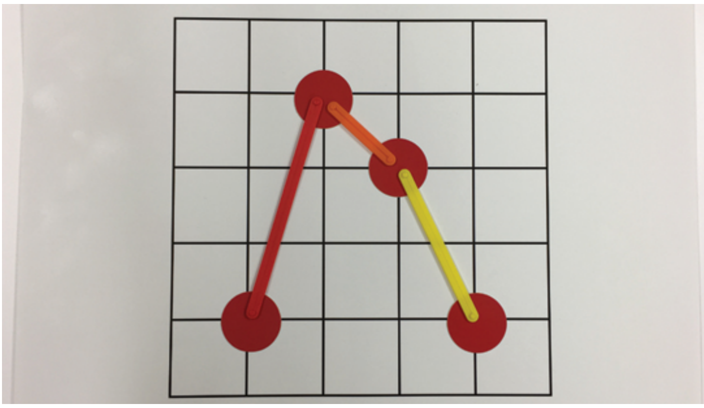
These sample adaptations are provided to illustrate the types of ideas that can be considered for students with significant disabilities to increase their independence in using math tools and materials as they learn about cause and effect and solving problems. The Equals Action Dictionary is provided in its entirety as part of the Equals math curriculum from AbleNet, Inc.

1. Students begin to learn about addition when they join sets and see what happens. To help a student complete that task when a student need support in handling manipulatives, anchor one set on a surface with sticky tac, Velcro or tape. The student then sweeps a second amount to join sets with a large craft stick, ruler, or hand.



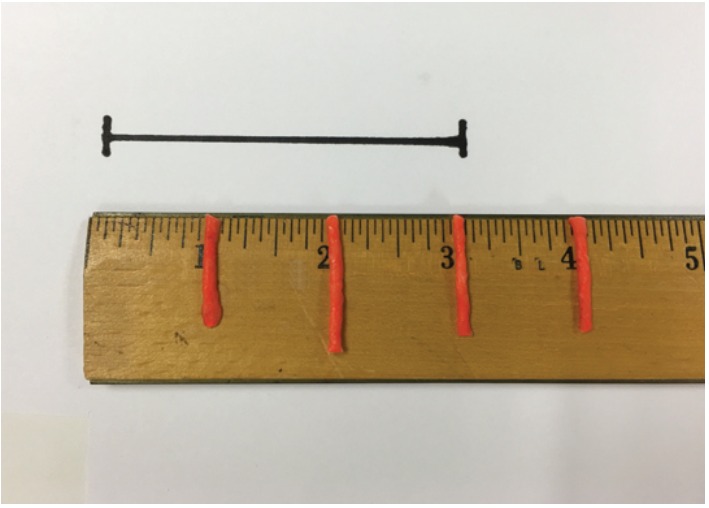
Student adds two sets with a tool.

2. For students who need support holding a pencil to draw points and lines in creating a line graph, use circle counters and AngLegs or Wikki Stix. The student places circle counters on or near the correct line and connect the circles with Wikki Stix or AngLegs as pictured here.



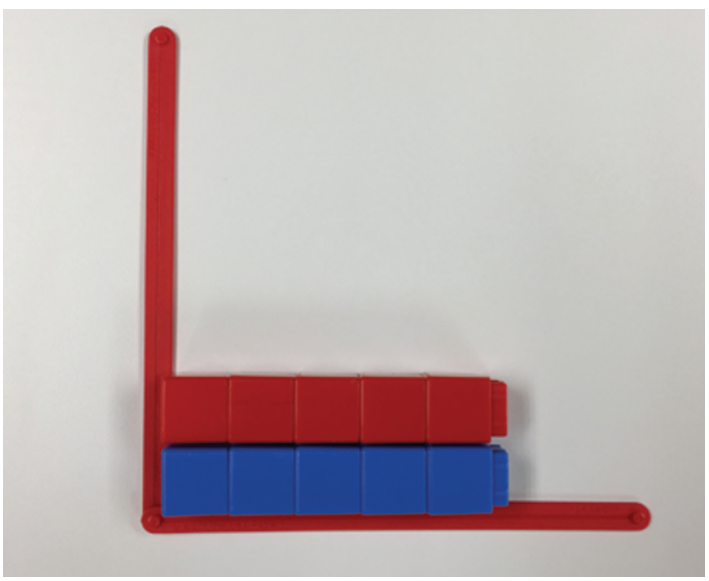
Student placed larger circle counters and Ang-Legs to create a graph.

3. When a student measures a line in whole inches and requires support to differentiate between 1" and ½" lines, adapt the ruler by fastening Wikki Stix to each 1" line.



Wikki Stix placed on each line of the ruler extends the length and provides a tactile line.

4. When a student is learning to use an array to multiply and the two-step process needs to be broken down into single steps, simplify the task. For solving 2 x 5 = ___, the student counts the number of columns (5) for each row and fastens them together into two rows (or asks a partner to help). Student places two rows of five into the corner of the right angle frame (made with AngLegs).



A three-dimensional array is easier to create and move.

5. To support building a rectangular prism with cubes, a straight edge is used to steady the figure so it remains vertical as the student is stacking the cubes. The straight edge also helps the student keep the cubes straight so it more closely resembles a whole three-dimensional shape.

The ruler is placed vertically to act like a barrier, holding the rectangular prism in place.

6. The Step-by-Step communicator is a sequential message device for recording, for example, numerals 1-10 for counting objects. It can also be used as a single message device for students to choose an answer from a display as the teacher points to each choice. Record "That's the one I want" or a similar phrase for the student to activate when the teacher points to the desired choice. ■

Single or multiple messages can be recorded on the Step-by-Step communicator.

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Closing The Gap 38th ANNUAL CONFERENCE

October 28-30, 2020

Preconference Workshops:
Monday and Tuesday, October 26-27, 2020

Mystic Lake Center
Prior Lake, Minnesota

Conference Welcome Reception:
Tuesday, October 27, 2020

Assistive Technology in Special Education, Rehabilitation and Everyday Living

CALL FOR PARTICIPATION

SUBMISSION DEADLINE
MONDAY, JUNE 1, 2020

SHARE YOUR EXPERTISE

Groups or individuals who wish to participate in Closing The Gap's 2020 Conference should submit their proposals for one-hour and multiple-hour presentations as soon as possible. Poster sessions will also be considered. The deadline to submit is Monday, June 1, 2020. Directions and information are found within. Please fill out the online proposal form completely; incomplete proposals will not be considered. Online submission is available at:

www.closingthegap.com/call-for-participation-2020

PROPOSALS

Closing The Gap will consider proposals for one-hour or multiple-hour sessions that describe and/or demonstrate successful applications of assistive technology for persons with disabilities.

Proposals are invited that report results of current applications; research; development of hardware, software or adaptive devices; model programs or procedures used by and for persons with disabilities.

Proposals for sessions that demonstrate the use of software programs, mobile apps, adaptive devices or the innovative use of assistive technology are highly encouraged – especially specific how-tos, tips and tricks and product comparisons.

Proposals should focus on practical applications, implementation strategies and best practices, rather than theoretical discourse.

Proposal content should be supported by evidence and should include quantitative performance data.

Proposals for open forums in which participants discuss, comment openly and share ideas and opinions relevant to a primary subject or focus are also encouraged.





CURRENT TRENDS AND TOPICS

Topics will cover a broad spectrum of technology as it is being applied to all disabilities and age groups in education, rehabilitation, vocation and independent living. People with disabilities, special educators, rehabilitation professionals, administrators, service/care providers, personnel managers, government officials and hardware/software developers will share their experiences and insights at what has become known as the best educational AT conference in North America.

REGISTRATION

Presenters may register for the three-day conference at discounted rates. Please visit the registration page for pricing details.

Presenters do not have to register for the conference to present; however, only those presenters who have registered may attend conference sessions/exhibits other than their own.

All-day preconference workshops are scheduled for October 26 and 27 and cost $295 for one day or $510 for two days.

PROCEDURE

Abstract: A 300- to 500-word abstract must accompany the proposal form.

Summary: A separate, 100-word summary must also be submitted for inclusion in the Conference Directory.

Proposal Form: The proposal form must be completely filled out and submitted online.

NOTIFICATIONS

Confirmation of presentation proposal acceptance/declination, and confirmation of specific date and time of accepted presentation will be sent by August 1, 2020.

In offering to present a paper, it is expressly understood that the presentation may be scheduled at any time on any of the conference days at the discretion of the conference organizers.

REGISTRATION OPTIONS

Conference - Wednesday, Thursday, Friday, October 28-30, 2020			
Registration Received	**On or before July, 31**	**August 1 - October 16**	**October 16 - Onsite**
Standard Rate	$505	$580	$605
Group Discount - 5 or more Group Discount - 8 or more Group Discount - 20 or more		Deduct $30 Deduct $50 Deduct $70	
Parent / Individuals with Disabilities *(A letter describing your child's disability must accompany registration.)*			$325
Full-time Student Rate *(Proof of full-time student status must accompany registration.)*			$325
Presenter / Exhibitor Rate Rate	$430		$530

Single Day and Exhibit Hall Only Registration	Price
Thursday Only - October 29	$320
Friday Only - October 30	$150
Exhibit Hall Only - Tuesday evening through Friday, October 27-30	$0

Preconference Workshops Includes Preview of Exhibits – Tuesday	Price
Monday, October 26 or Tuesday, October 27	$295 per day
BUNDLED PRICING! Monday and Tuesday Bundle ($80 savings)	$510

RESNA Two-Day ATP Fundamental Course	Price
Monday, October 26 & Tuesday, October 27	$650 for RESNA Members; $800 for non-members

NEW! **Conference Registration Includes Breakfast!**
Restrictions Apply. *Visit www.closingthegap.com/conference for full details.*

VALUE! Breakfast INCLUDED

ADMINISTRATORS PARTICIPATE FREE! BRING YOUR TEAM

When any school district or hospital staff member registers for a preconference workshop or the conference, one administrator from that organization can attend the conference, for **FREE**!

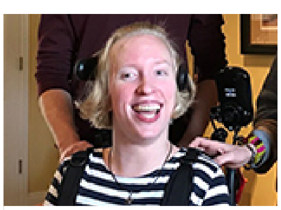
CONFERENCE SCHOLARSHIP

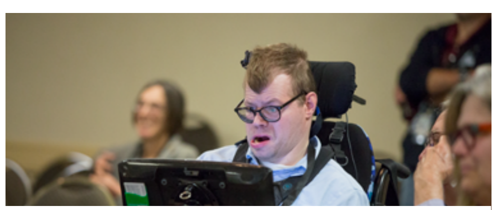
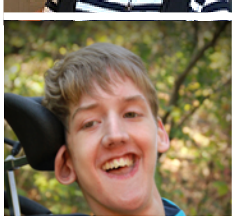
A limited number of scholarships are available for persons with disabilities or parents/guardians of children with disabilities. Scholarships are awarded on a first come, first served basis and one time only per person.

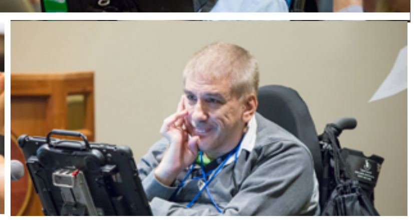
DISCOUNTS

Complete details available online at www.closingthegap.com/conference

- **$25 RETURN DISCOUNT**
  A $25 "RETURN" DISCOUNT is available to ANY past conference registrant and must be used by JUNE 30, 2020. This discount can be used for any preconference workshops OR conference registration.
- **CLOSING THE GAP SOLUTIONS MEMEBER DISCOUNT**
  A $50 discount is available to Standard Solutions Members. A $100 discount is available to Premium Solutions Members.
- **RESNA MEMBER DISCOUNTS**
  A $100 discount is available to RESNA Members.

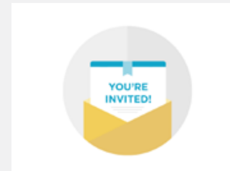




JOIN US

CONFERENCE WELCOME RECEPTION



Tuesday, October 27
4:30 pm - 7:00 pm

Don't Miss Your Chance to Score **EXCLUSIVE** Prizes, Incentives and Offers!

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$169 - double occupancy
$179 - triple occupancy
$189 - quad occupancy
(Plus applicable state and local taxes.)

- Use code CLOSING20 to book your stay at mysticlake.com/hotel
- Please refer to the "Closing The Gap Conference" when making your reservations by phone to receive conference room discounts when applicable.
- To ensure attendees receive the negotiated group rate, reservations are required by **FRIDAY, OCTOBER 9, 2020.**

UPCOMING LIVE WEBINARS

PROFFESIONAL DEVELOPMENT

CEUs are provided by the AAC Institute and are available for live webinars at no additional fee (does not include sponsored webinars unless noted). A 60-minute webinar = 0.1 CEUs. A 90-minute webinar = 0.2 CEUs

Setting it Up and Making it Work: Strategies to Improve School Based AT Services

By Keri Huddleston
Thursday, April 23, 2020
3:30 pm – 5:00 pm (Central Daylight Time)

Providing AT services in schools is almost always a work in progress. Whether constructing a new program, attempting revitalization, or coping with changes, AT professionals frequently recognize room for improvements. Fixing problems is at the core of who we are and what we do, from the lone service provider at a school, to a district team, or even an entire state program.

After 25 years in the public-school system serving a large geographical area and high numbers of students with diverse needs, Keri understands the challenges that come with serving students, families, and staff. She will share specific, easily applicable steps you can use right away to drive progress in your programs, empower you to serve, and help achieve concrete goals.

Learning Outcomes:

1. As a result of the webinar, participants will be able to analyze service delivery options.
2. As a result of the webinar, participants will be able to describe specific strategies to improve their services.
3. As a result of the webinar, participants will be able to create an action plan.

Supporting Emergent and Basic Math on the iPad

By Mark Coppin
Thursday, May 7, 2020
3:30 pm – 5:00 pm (Central Daylight Time)

Basic math skills are needed to make store purchases, determine necessary quantities, calculate distances and more. There are some basic math skills that every student can and should learn during their math education program. This webinar will cover a wide variety of apps that work on emergent math concepts such as numbers, counting, patterns, etc… through basic concepts such as addition, subtraction, multiplication, division, decimals and fractions. Participants in this webinar will discover solutions and apps to support their students as they continue down the path toward math literacy.

can make math more accessible to all students. This webinar will discuss apps and extensions for making math activities accessible. We will cover various calculator apps, electronic math paper apps, accessible math apps, math extensions and other ways to make math more accessible.

Learning Outcomes:

1. Identify 3 emergent math skill areas
2. Identify 3 basic math areas
3. Identify 3 apps for access to math

Early Childhood AT Supports for Potty Training

By Ellie Hamilton
Thursday, May 21, 2020
4:00 pm – 5:30 pm (Central Daylight Time)

All children potty train at different times based on their individual development. Children with disabilities may need additional support and assistive technology items to be successful.

Participants will be introduced to evidence-based assistive technology supports, tools and resources to use for children with disabilities during potty training. The indicators to watch for when a child is ready to begin potty training will be shared and how to create an accessible bathroom experience for all children.

Learning Outcomes:

1. As a result of the webinar, participants will be able to identify three evidence-based practices.
2. As a result of the webinar, participants will be able to identify three data collection tools.
3. As a result of the webinar, participants will be able to identify three early childhood potty training apps.

Engaging and Interactive!

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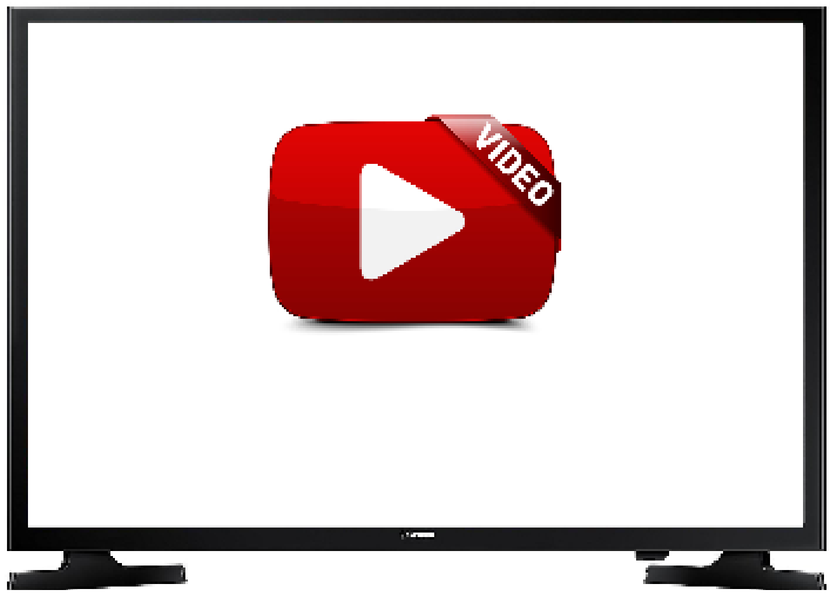

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Technology Assisted Active Learning: Aarna's Case Study

Summary - *This article will examine challenges to active participation in experiences necessary for the development of foundational semantic and cognitive skills in learners with severe intellectual disabilities, sensory loss and motor impairments. It will describe the intervention designed for one learner - Aarna.*

INTRODUCTION

From the moment they are born, infants strive to learn everything they can about where they are and what is happening to them. Gradually, if environments are predictable, manageable and meaningful, they develop a sense of coherence. When environments are coherent, learners seek more information about objects and people. When environments are incoherent, learners avoid interactions with objects and people that they cannot understand and therefore perceive as aversive or threatening. Development and maintenance of a sense of coherence is the primary goal of learning for humans throughout their lifetimes. How successful any given person is in achieving this goal is highly related to physical and psychological wellness (Amirkhan and Greaves, 2003).

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Learners with severe intellectual disabilities, sensory loss and motor impairments need carefully designed interventions to help them develop the understanding that leads to a sense of well-being and the desire to learn more about the people and objects in their environments. Gradually, learners expand their experiential base to include new experiences and environments that are more complex. Consideration of three areas is essential for the development of coherence.

- Active learning
- Cognitive skill development
- Semantic development

Each of these areas, described below, presents unique challenges for learners with severe multiple disabilities. The case study described in this article examines the strategies for addressing these challenges, including the use of technology.

CHALLENGES

ACTIVE LEARNING

Learners are active when they participate in an experience with the intent to move some part of their bodies to interact with something that is part of the experience. Active learning is important at any stage of learning, but it is crucial at the sensorimotor stage—birth to two years in typical development. Neurological evidence shows that motor responses increase brain activity to the levels required for long-term memory storage. Passive exposure during experiences stimulates short-term or working memory and is important for creating the alertness required for attention, but it is not sufficient for the assimilation and accommodation of information that leads to the development of coherence (Moreau, 2012). A learner may like looking at the light emitted by an object as it moves in his visual field, but when the light goes away, he has not learned anything about the object or his relationship to it. In order for learning to occur, he must touch the object and try to do something with it.

The motor responses necessary for long-term memory storage, the essential element of learning, do not require muscular execution of movement. When learners mentally image desired movements, motor responses are sufficient for long-term memory storage. In other words, learning is active when movement is intended and imagined (Jeannerod, 2008). Early research using tomography to measure brain activity during motor events showed that activity was highest during the preparation and initiation stages of motor response and much less intense during the execution of response. More recently, the use of additional tools like functional MRIs to study motor cognition has led to the development of innovations such as robotic exoskeletons operated by mental imaging. Motor execution is highly desirable, but when it is not possible, learners may achieve coherence when teaching partners help them understand what is happening, so that they can think about what they want to do (Kappes and Morwedge, 2016).

COGNITIVE SKILL DEVELOPMENT

Cognitive skills develop over time as learners actively participate in interactions with people and objects. Brain scans show that when environments provide the right conditions for high quality interactions, experiences build new neural networks in the brains of all individuals with some viable cortex, regardless of age or ability level (Menshew and Williams, 2007). Interactions are high quality for learners with severe multiple disabilities when they are highly motivating, consistent, repeated frequently and contain needed supports and accommodations.

The cognitive skills that form the foundation for all learning emerge largely hierarchically from birth to two years in typically developing children: the period known as Piaget's sensorimotor stage. For learners with severe multiple disabilities, opportunities to learn cognitive skills are an essential part of programs at any age. In highly effective interactions, learners develop new cognitive skills and/or strengthen existing skills by participating in experiences at higher levels and by expanding existing skills to new experiences (Ormrod, 2012). Cognitive skills develop when learners actively participate in activities. When actions are intentional, brain function is primarily cortical. During the reflexive movement period of very early infancy, brain function is primarily sub-cortical. Over time and under the right conditions, some reflexive behaviors become skills. Sensorimotor stage cognitive skills typically include the following (Parks, 2004):

- Anticipation
- Exploration
- Object permanence
- Cause and effect
- Imitation
- Tool use or means/ends
- Spatial relationships

Passive attention makes cognitive development possible because it creates the neurological conditions necessary for active

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learning. Anticipation starts passively when learners associate two contiguous events initiated by and carried out by another person. A hungry infant might stop crying when she hears her approaching mother's voice and anticipates feeding. Active learning is required for continued development (Ranganath and Richey, 2012).

Exploration is intentional and active for two reasons: It processes sensory components of objects in an effort to find attributes that provide pleasure, and it uses those attributes to evoke memories of previous experiences with the sources of those attributes. This results in object identification. At first, a neonate reflexively sucks anything that touches his mouth. As he begins to move his mouth intentionally over his mother's body, he learns that some parts of the body have the sensory components he finds pleasurable and some do not. He sucks when he identifies the part of the body that provided food in the past (Richmond and Nelson, 2007).

Object permanence, the understanding that a thing continues to exist when there is no direct sensory perception of it, develops as experiences store up in long-term memory. An infant explores a toy, discovers a sensory component that he likes, loses contact with the toy, and searches for it when he wants to experience the pleasurable attribute again. At first, an infant initiates a search almost immediately after separation. Gradually, longer intervals occur. During snack time, a learner might eat crackers for several minutes before he gets thirsty and searches for his cup of juice (Bremner et al, 2015).

Cause and effect skills emerge when learners want to make something they enjoy happen again. The relationship between the learner's body and the object acted upon is direct. The learner may achieve the desired effect with movement of any part of her body. She demonstrates understanding of cause and effect relationships with planned and initiated movements. The cognitive skill develops with or without full execution of the desired action. Searching for a spoon is object permanence. Picking it up and banging with it is cause and effect. The action of the hand with the spoon is the cause and the sound of banging is the effect. At first, cause and effect behaviors are egocentric. What other people do with spoons is not important yet (Saxe and Carey, 2006).

When the relationship of objects to other people becomes interesting, the skill of imitation emerges. Attention to the actions of another person is typically visual. Visual attention activates mirror neurons that stimulate activity in the motor processing parts of the brain. The patterns of electrical activity in the watcher's brain mirror those of the doer. Imitation occurs when the watcher plans and initiates the doer's action. Full execution of the action is not necessary for coherence—understanding what is happening (Meltzoff and Prinz, 2002). Visual modeling is a powerful tool for creating motor imaging. Tactile modeling also creates motor imaging. Tactile modeling is not hand-over-hand manipulation. Rather, it is hand-under-hand support during which, to the maximum extent possible, the watcher's hand 'rides' the doer's hand (Chen and Downing, 2006).

When a learner wants something to happen (an effect) and cannot cause it to happen directly with the movement of some part of her body, tools solve the problem. Tool use or means/ends skills require the learner to understand the relationship not simply between her own body and the object she wants to effect, but also between her body, the tool she will use and the object that is the source of the desired effect. Using the hand, head or foot to tap the touch screen on a device to hear the sounds it produces is cause and effect. Using the hand, head or foot to press a switch that activates a sound source is tool use or means/ends. The relationship between the body and the object is no longer direct. There is now a three-way relationship between the body, the tool and the object. Establishing direct body/object cause and effect relationships helps learners understand that the switch tool is not the source of the desired effect (Deak, 2014).

The development of spatial relationships starts with exploration and becomes more refined as skills develop. First, an infant learns the spatial relationships related to his own body parts. He can put his thumb in his mouth. He then learns the spatial relationships between his body and the objects around him. He can put a toy in his mouth. Still later, he develops understanding of the spatial relationships of objects to other objects. He can put the toy in a box (Vasilyeva and Lourence, 2012).

SEMANTIC DEVELOPMENT

Semantics is the study of the development of meaning in language. When a word has meaning, hearing it calls to mind experiences with the thing to which the word refers. This mental lexicon is a powerful tool for developing coherence. When learners understand the meaning of words, they can predict events and organize experiences into categories that generalize to multiple contexts. Meaning develops sequentially in interactions with objects and people (Pecher and Zwann, 2005).

- Sensory component processing: How does the thing look, feel, sound, taste and smell?
- Comparison: How is it similar to or different from other things?
- Evoked memory: Do attributes call to mind previous experiences with it?
- Use: What can I do with it?
- Relationship to others: What do other people do with it?
- Naming: What do people call it?

Each step in the chain presents unique challenges for learners with severe multiple disabilities. When visual impairments, hearing loss and motor impairments limit access to information, accommodations for sensory component processing and comparison make

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learning more efficient. Random passive exposure to the sensory attributes of objects may create short-term attention, but in order to create coherence, an experience must be predictable, manageable and meaningful. When participation in an experience consists mainly of physical manipulation of a learner's body, she may not have a chance to learn what other people do with objects, because no one modeled those actions for her. Names of things important to the learner may get lost in sentences containing many random unfamiliar words.

In typically developing children, these important names are the words that acquire meaning first. Usually they include names of favorite people, foods, toys and actions. Infants and toddlers understand the meaning of words before they can say them. A typical two-year-old child comprehends the meaning of about 200 words and says about 20. A toddler knows he is going to get a cookie when he hears that word while sitting in his high chair, long before he can ask his mother for a cookie by saying the word (Hoff, 2013).

Programs for learners with severe disabilities facilitate semantic development (i.e., understanding the meaning of words) most effectively when they build a solid experiential base for concepts about people and objects and when they pair symbols like words and pictures with the things they represent before using them alone (Kucker, McMurray, and Samuelson, 2015). Some programs tend to emphasize expressive communication skills almost exclusively. Words without meaning may be a useful stimulus for evoking a desired response in a specific context, such as an auditory scanning device, but they may not have the true symbolic content that makes them understood when used by different people in different contexts. Similarly, picture usage may occur with or without meaning. Conditioned stimulus/response relationships are useful. Most people's phone displays have some images that are meaningful and recognizable in multiple contexts, while recognition of other images may rely on attributes such as color and location in one context only. Empowering learners in tasks such as choice making using non-representational arbitrary images can be effective; however, it is not semantic development. Understanding the meaning of symbols so that they can be used in multiple contexts is even more empowering.

INTERVENTION

The individualized education plan (IEP) team featured here used strategies and tools contained in The Sensory Learning Kit (SLK) (Smith, 2005) to design the intervention described here. The SLK organizes skills related to semantic development and cognitive development into three zones of sensorimotor stage function. The quiet alert or attention zone begins with the semantic development skill of passive sensory component processing and the cognitive skill of anticipation. The active alert or exploration zone includes active sensory component processing, comparison and egocentric use in semantic development and exploration, object permanence, cause and effect and imitation in cognitive development. In the partial participation or function zone, semantic development progresses to the understanding of what other people do with objects and to thinking of things named by others. Cognitive development expands to tool use and complex object to object spatial relationships.

From October through December of one school year, Aarna's IEP team used the SLK to assess her needs and plan her intervention. The team followed her progress from the initiation of instruction in January through the next five months. During that time, Aarna was a second grader receiving homebound services due to a repressed immune system. Her IEP team included her homebound teacher, teacher of students with visual impairments (TVI), physical therapist, occupational therapist and assistive technology specialist. Her parents, grandparents and private duty nurse provided valuable information throughout Aarna's intervention. After using SLK tools to review medical conditions and current evaluations, the team began the intervention by observing a regularly occurring familiar activity in order to establish a baseline or present level of cognitive/semantic performance from which to measure progress. Aarna's present level was quiet alert/attention zone. During a lotion activity, she maintained alertness throughout, smiled and vocalized while responding to her teacher's voice and touch and occasionally visually fixated on her teacher's face.

To see Aarna's Lotion Activity watch December—Establishing Baseline at (**Beginning, next page**)

The team designed the first instructional activities in Aarna's intervention to develop the active alert/exploration zone cognitive skill of cause and effect. They knew that to be effective these activities would need to be highly motivating and consistent, repeat frequently and contain needed supports and accommodations. Aarna's TVI and homebound teacher used an SLK assessment tool to identify attractive sensory topics for Aarna's activities and to identify accommodations that made sensory access to media more efficient. Using this information, the team determined that the best topics for activities were the following:

- faces (with complexity reduction in the visual field)
- human voice
- lotion (with slow rhythmic pressure)
- bells
- iPad®

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Aarna's Lotion-Activity watch December - Establishing Baseline at (**Beginning**)
To see Aarna's Move Bells Routine watch January—Exploration at (**Timeline: 46 seconds**)
To see Aarna's Patterns and Music Routine watch May—Function Level, Patterns and Music at (**Timeline: 6:07**)
To see Aarna's Rufus Reading Routine watch May—Function Level, Rufus Reading at (**Timeline: 9:13**)

YouTube Video Link: https://www.youtube.com/watch?v=RbQnwin2Qz8

The instructional strategy used in the SLK is called 'routines.' It is based on the evidence that highly structured activities conducted during direct instruction result in higher levels of achievement for learners with disabilities. Teams should design routines for maximum consistency, use the same sequence of steps, and guarantee they occur frequently—at least once daily.

In January, Aarna's team began her intervention with a Move Bells routine. The team collaborated to develop a lesson plan (Table 1: Sensorimotor Routine Lesson Plan—Move Bells) for the routine to ensure maximum consistency and to document progress on the embedded cognitive skill of cause and effect.

When Aarna demonstrated mastery of active alert/exploration zone cause and effect skills, her team developed routines targeting partial participation/function zone skills. The iPad® was the highly motivating topic for these routines. Aarna demonstrated in her Move Bells routine that she enjoyed moving her body to create sound. Her goal in her iPad routines was to demonstrate that she could use a tool to create sounds.

Aarna's team developed two iPad routines. In the first, as shown in Table 2: Sensorimotor Routine Lesson Plan—Patterns and Music, Aarna used an adaptive switch tool to activate visual patterns and music on her iPad. She moved her head to a pressure switch to restart the program after pauses. Team members made sure that Aarna's homebound teacher taught her the routine with

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Table 1: Sensorimotor Routine Lesson Plan—Move Bells

Student	Aarna	**Materials**	Bells, mat, wedge, now container
Routine	Move bells	**Position**	Supine on mat, upper torso elevated with wedge
Teaching partner	Mallory	**Frequency**	1 x daily
Observing team members	VI, PT	**Duration**	10 minutes
Location	Home, downstairs bedroom	**Data period**	Feburary 2-6

Learner's Steps	Partner's Supports and Accommodations	Embedded Goals Target Level: Exploration	Documentation
1. Read object schedule: Look at bells in now container.	Present now container in right peripheral field and move slowly across midline to left. Move container to provide sound of bells ringing during presentation. Place orange fabric on bell bracelet to attract visual attention. Use now container to provide high contrast and complexity reduction.		
2. Read object schedule: Touch object after 3-second visual fixation.	Use elbow support to help Aarna touch bells after looking.		
Round One: Mallory models the sequence			
3. Move right hand.	Place bells on hand. Say, "The bell is on your hand. Move hand." Tactually model action by moving hand. (Repeat for 4-9 with correct body part name)		
4. Move right foot.			
5. Move left knee.			
6. Move left foot.			
7. Move right foot.			
8. Move right knee.			
9. Move head.			
Round Two: Aarna's turn			
10. Move right hand.	Place bell on Aarna's hand. Say, "The bell is on your hand. Move hand." Wait 12 seconds for Aarna to move. If she does not move after 12 seconds, repeat the prompt. If there is no movement after an additional 12 seconds, say, "I'm going to help you." Move her hand. (Repeat for 11-16)	Aarna will demonstrate understanding of the cause and effect relationship between the part of the body she moves and the sound movement produces.	+/+/+/+/+
11. Move left Hand.		Same as above for 11-16	-/+/-/-/-
12. Move left knee.			+/+/+/+
13. Move left foot.			-/-/-/-/+
14. Move right foot.			+/+/-/+/-
15. Move right knee.			-/-/-/-/-
16. Move head.			-/-/-/+/-

To see Aarna's Move Bells Routine watch January—Exploration at (**Timeline: 46 seconds**)
https://www.youtube.com/watch?v=RbQnwin2Qz8

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Table 2: Sensorimotor Routine Lesson Plan—Patterns and Music

Student	Aarna	**Materials**	Wheelchair tray, arm clamp, yellow pressure switch, iPad, now container, finished container, book light
Routine	Patterns an d Music	**Position**	Seated in wheelchair
Teaching partner	Mallory	**Frequency**	1 x daily
Observing team members	VI, PT	**Duration**	15 minutes
Location	Home, downstairs bedroom	**Data period**	April 20-24

Learner's Steps	**Partner's Supports and Accommodations**	**Embedded Goals** **Target Level: Exploration**	**Documentation**
1. Read object schedule: look at whole object symbol in now container	Turn off ceiling lights and attach book light to now container. Present now container with iPad in upper left field. Say, "It's time for iPad." Move container slowly across midline to right field.		
2. Move head to restart program.	Wait 30 seconds after the ding to allow time for Aarna to think about what she wants to do. If Aarna does not start her program after 30 seconds say, "Are you done?" Wait another 30 seconds to see if Aarna wants to keep going.	Use tool (head switch) to activate device for specific purpose.	M: 7 activations T: 9 W: 14 TH: 7
3. Put iPad in finished container.	Say, "iPad done," when initiation takes longer than 30 seconds or when 15 minutes is up.		

To see Aarna's Patterns and Music Routine watch May—Function Level, Patterns and Music at (**Timeline: 6:07**)
https://www.youtube.com/watch?v=RbQnwin2Qz8

Table 3: Sensorimotor Routine Lesson Plan—Rufus Reading Routine

Student	Aarna	**Materials**	Wheelchair tray, arm clamp, iPad, yellow pressure switch, now container, finished container, book light
Routine	Rufus Reading	**Position**	Seated in wheelchair
Teaching partner	Mallory	**Frequency**	1 x daily
Observing team members	VI, PT	**Duration**	30 minutes
Location	Home, downstairs bedroom	**Data period**	May 25-29

Learner's Steps	**Partner's Supports and Accommodations**	**Embedded Goals** **Target Level: Exploration**	**Documentation**
1. Read object schedule: look at whole object symbol in now container	Turn off ceiling lights and attach book light to now container. Present now container with iPad in upper left field. Say, "It's time for iPad." Move container slowly across midline to right field.		
2. Turn pages in Rufus book.	Wait up to 30 seconds for page turn. After 30 seconds, say, "Try again."	Aarna will use a tool (switch) to activate a device for a specific purpose (turning pages).	M: 20/20 pages T: 20/20 W: 20/20 TH: 20/20 F: No school
3. help put iPad in finished container.	Say, "The end. Good reading Rufus."		

To see Aarna's Rufus Reading Routine watch May—Function Level, Rufus Reading at (**Timeline: 9:13**)
https://www.youtube.com/watch?v=RbQnwin2Qz8

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Aarna uses a switch, positioned at her cheek, to change visual and auditory presentations during her Music and Patterns iPad Routine. The screen shows yellow shapes on a black background.

Aarna uses a switch with her cheek to turn the pages of her Rufus Reading iPad Routine.

optimal accommodations and supports. Screen displays with high contrast and movement increased visual attention. Positioning for comfort and trunk stability allowed Aarna to move her head to press the switch and to shift her gaze between her teacher and the iPad screen. An arm clamp attached to her tray elevated the iPad so its positioning was in Aarna's best viewing area, which is upper central.

Sometimes routines become overly familiar and performance declines because of boredom. The team decided to develop a new iPad routine designed to maintain high motivation and to expand skills. Aarna's new routine was Rufus Reading. One of the items on Aarna's list of highly motivating topics for routines was human voice. Aarna paid intense attention to voices in her environment. She knew when someone addressed her and she worked hard to look at her social partners. In social speech, attention to attributes such as intonation and changes in pitch and rhythm provides cues for interpreting emotional content. In her Rufus Reading routine, Aarna used her head switch to turn pages as she listened to the language in her story. In this context, intonation and changes in pitch and rhythm are part of syntax development, (i.e., attention to the arrangement of words and phrases). In early development, interest in the structure and rhythm of language exists with or without semantic content (i.e., understanding the meaning of the words heard). Aarna may have understood some of the words she heard in her Rufus Reading routine. She clearly demonstrated that she understood some of the syntax of the language she heard. She waited until a sentence finished before she initiated a social comment directed toward her teacher—a smile or a laugh—and she anticipated favorite parts of her story as demonstrated by smiling and laughing when the preceding text was heard.

CONCLUSION

Learners with severe multiple disabilities need high quality interventions designed to help them understand what is going on in their environments. When they are free of the stress caused by incoherence, they confidently interact with people and objects. Semantic and cognitive skills develop because of these interactions. Active participation is required. When motor impairments prevent full execution of actions, a learner's mental imaging of actions helps to achieve active learning. Learners must understand what is happening in order to imagine what they want to do. Aarna developed coherence for the three activities described here because they provided the motivation, consistency, repetition, and accommodations/supports she needed. She used mental imagery and limited movement, with and without assistive technology, to develop semantic and cognitive skills. Some motor responses, such as the movement of her left foot, improved over time. She progressed from a baseline of quiet alert/attention zone skills to partial participation/function zone skills over five months.

PRODUCT INFORMATION

American Printing House

Sensory Learning Kit American Printing House for the Blind - The SLK is research-based and uses best practice strategies that align with the common administrative practices in place in most special education programs. The material contained in this product gives teachers of learners with visual and multiple impairments the tools to

- conduct sensory efficiency and learning media assessments;
- address IEP areas such as instructional settings, accommodations, and goals; and
- provide highly effective instruction using a collaborative, consultation-service delivery model.

Sensory Learning Kit - American Printing House

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The UDL framework states that we should provide "multiple means of Action and Expression."

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As teachers and therapists, we need to create learning activities, environments and technology systems which will encourage our students to uniquely express themselves and help them to independently show what they know. Our students should be using systems to independently show what they know in confident, expansive and motivating ways.

Our children, from the youngest age, are eager to show what they know and to tell us what they think. Every child, regardless of their ability to talk, has an innate desire to communicate thoughts, feelings, experiences, emotions, information and opinions. For those children who develop verbal language skills, they will quickly tell us what they think and what they want. For those who do not develop typical language skills, they will find ways to communicate with actions, gestures, sounds, behaviors, etc. Every child has valuable information, opinions and ideas and as parents and educators, it is our responsibility to find ways that children can independently and effectively communicate and record all of that information, in writing.

The term 'writing' has long been used to describe the recording of information as text. In fact, the Oxford dictionary defines 'writing' as "The activity or skill of marking coherent words on paper and composing text" and "The activity or occupation of composing text for publication".

Merriam Webster's English Language Learners Definition of writing is "The way that you use written words to express your ideas or opinions". In the world of UDL thinking, and given current multimedia technologies and methods, this is a good definition. However, our thinking about writing should be even broader. Children can write and show what they know, think and feel using a wide range of multimedia technology tools and strategies, including text, voice/audio, video, drawing, and images.

Writing is a powerful means for people to record and document anything they want to. Apart from the need to write for academic and learning purposes, all children and adults need to be able to write as a lifelong skill. There are concrete and obvious reasons for the need to write, writing to show academic knowledge in the school environment or college environment, as well as writing needs in jobs and careers. However, writing is far more

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than academics and work.

Writing allows individuals of every age to record their:

Ideas
Dreams
Experiences
Knowledge
Information
Understanding
Events
Opinions
Feelings and emotions
Their personality
Stories and creativity
And anything they want

Writing, and recording information is a personal, creative and highly individual process. By writing, people can express who they are, their personality, interests and absolutely anything they want that is important to them.

Every one of our children should have the opportunity of doing this, and be able to write and record information at their highest cognitive level and highest potential. In other words, our children should be using methods of writing that truly allow them to independently write and record their information. We need to provide them with systems that remove the barriers to effective writing. The way in which we remove barriers is by providing them with multiple methods of expression and multiple methods of producing writing.

Students need technologies and strategies that allow them to demonstrate knowledge, show what they know and independently record their ideas, feelings, thoughts and anything else they want to write about.

We need to define writing in the broadest way if we are going to assist our students in writing with multiple methods of expression. Traditional definitions of writing have included handwriting on a page and typing on a keyboard. With both methods, handwritten text or typed text is produced on a page (either a physical page or a screen). Traditionally, in the classroom, handwritten text on the page or printed text from a computer was turned in to the teacher. In the last few years, and with the growth of online file saving/collaboration sites such as Google documents, Google Classroom, Schoology and Seesaw, students are now able to work in a more digital environment. Nowadays, multimedia technology tools are abundant. We are seeing massive growth of varied online multimedia educational technologies, as well as handheld/tablet applications. Our students have more opportunities than ever to engage in writing in many different ways. We have to move away from the primary focus of handwriting and typing as methods of writing.

Handwriting and typing are still important skills. However, in addition to these methods of writing, our students should be using other methods to show what they know, together with trials and data collection to determine the most effective and efficient method/s of writing production.

5 METHODS OF WRITING PRODUCTION

There are five methods for students to show what they know, to record their ideas and to 'write':

1. Drawing
2. Handwriting
3. Typing
4. Voice recording
5. Speech recognition

Traditionally, children have produced 'writing' with handwriting or typing. In some classrooms and educational environments, however, students are being exposed to different multimedia or technology-based writing opportunities. As teachers and therapists learn about more multimedia applications and systems, students are being given options of creating content using a wider range of writing or recording methods. While multimedia writing and learning technologies are motivating and interesting, they do not automatically result in more effective, efficient or accurate writing. Some applications with high-interest media features might increase motivation for writing but, in some cases, might be distracting, visually complex, and may result in more experimentation and playing than actual production of high-quality content.

When considering the five methods of producing and recording information, as well as the enormous range of variables in terms of how students write, it is essential for students to participate in a structured and carefully planned approach to help them develop the highest levels of writing skills they can be given their own cognitive skills and creativity. It can be counterproductive and a waste of time to simply try out a range of "fun and motivating" multimedia programs. We need systematic, meaningful data, carefully collected over time, to show real progress and to make data-driven decisions about how to best help each individual student with writing. Effective writing takes many years to develop and continues to develop through life. As educators and therapists, we need to make full use of all of the exceptionally useful technology options available but must do this in a highly structured data-driven manner.

Each child learns differently and will develop writing skills based not only on their own unique needs but also on the writing tools, strategies and approaches we provide over time. This is not a few weeks or a few months, this is years of training and practice.

Effective data collection for writing production involves quantitative data and qualitative data.

Quantitative data includes writing speed and accuracy with numbers, empirical data, measurement, graphs, words per min-

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ute, percentages.

Qualitative data includes observations, discussion and opinions from the teacher and student. Qualitative data is subjective and descriptive.

Data or information about how a student writes/records information can be one point in time. This is a single data point or a one-time evaluation of a student's efficiency or effectiveness of writing production. It can include both quantitative and qualitative data information, but it does not give information over time. One evaluation session does not give information about trends or essential information needed about the effectiveness of interventions, strategies or training methods.

Data over time is essential. If we are to create a systematic approach to training and developing highly effective writing skills, we need carefully planned and detailed data collection. This data should include not only the numbers for quantitative data and opinions and discussion for qualitative data, but it should also include detailed information on the writing methods and other variables, such as hardware and software accommodations, software settings, positioning supports, etc.

Apart from the five methods of telling what they know, there are unlimited variables and options for writing production.

In an evaluation of a student's need for writing supports, the SETT framework (for assistive technology evaluation) is an excellent method of identifying each student's own unique needs, the demands in terms of their writing and expectations for writing. The next steps are identification of possible technology tools and planning for trials, training and implementation. More information about AT evaluation and SETT is at www.joyzabala.com.

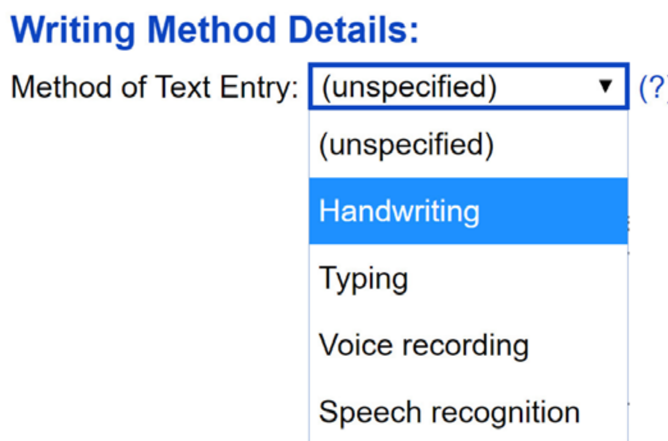
Once possible tools and strategies are identified, it is essential to have a structured plan for introducing the technology, trials, training and data collection.

The **Online Assessment of Writing Methods** has been recently developed by Bridgette Nicholson (Occupational Therapist/Assistive Technology Consultant). http://typingtraining.com/writing_methods.html

This was developed in response to the need for a place to plan and document every aspect of the writing production process for all methods of writing. This online tool allows children of every age, grade and skill level to produce writing and to show what they know with every method and technology available. It provides a place for automatic, real-time measurement of quantitative data (words per minute and accuracy percentage) while allowing adults and students to provide opinions and discussion about different types of technology tools and setups for writing. The tool was developed specifically to record every variable related to writing, including not only the technology tools but other variables including low or light-tech setups, environmental considerations and all variables related to writing production. It allows for evaluation of writing over a period of time, using different setups and technology tools and gives the option of comparisons graphs and data, comparing a student's proficiency and accuracy with different setups.

The Online Assessment of Writing Methods was developed specifically for trials of different writing setups (with all variations and options recorded), with data collected over time and to give reports and information of quantitative and qualitative comparisons of different writing methods

Students can participate in four methods of writing production on this data collection site. All exercises record speed and some (copy typing exercises) record accuracy. Each exercise can be graded by the teacher with the additional option for narrative description, discussion and opinions by educator and student.

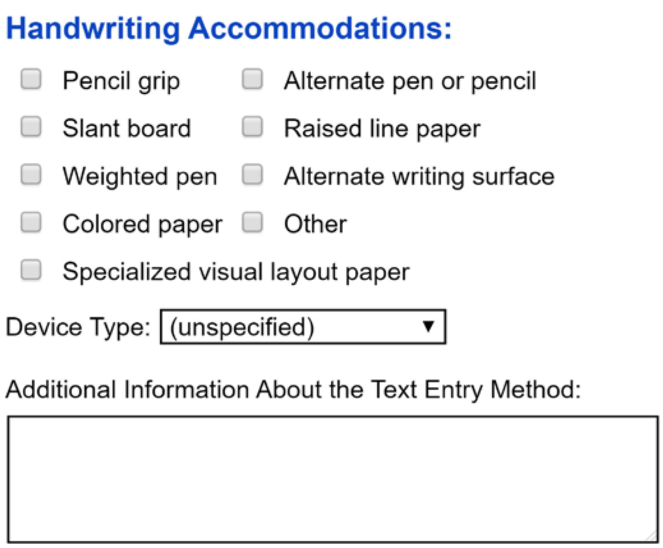


Writing Method Details.

As each method is selected, the options and variables for each method will be shown. All sections have an area where additional information unique to each setup can be documented.

HANDWRITING

Child Handwriting on a Page



Handwriting Accommodations

If handwriting is selected, these variables are provided.

These are just a few of the more common light-tech or no-tech writing accommodations. Add detailed information in the Additional Information section to describe the full writing setup.

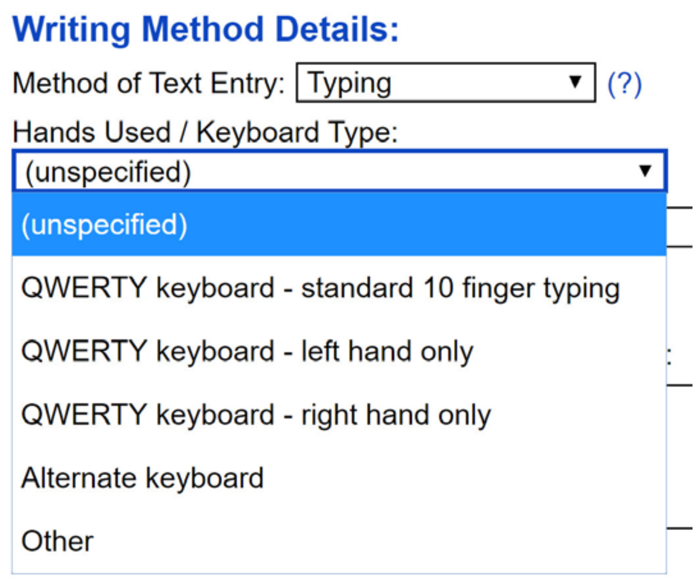
Test or Data Collection session:

The student does the writing exercise while the website records the time. Once the student is done, they take a photo of the page. The site performs OCR on the writing, transcribes the writing into text in the background and provides a words per minute calculation.

TYPING

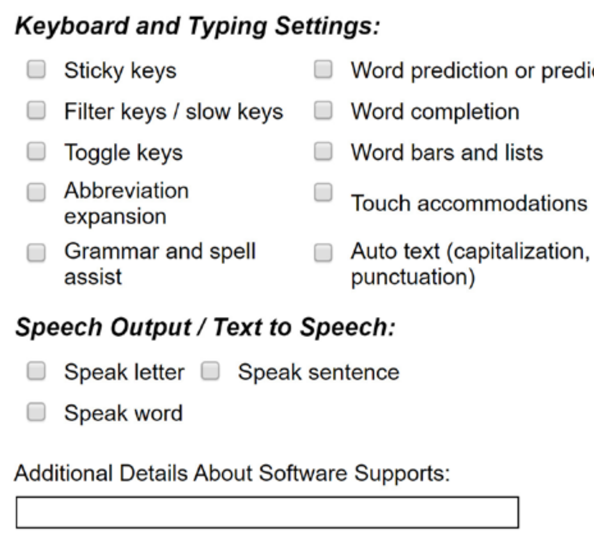
Child Typing

If typing is selected, these variables are provided.



Keyboard Size

Here, you can record detailed information about the method of typing, including type of keyboard and hardware. If an alternate keyboard is used, it should be documented here. The name of the text input device, including hardware and software should be documented. Some of the more typical software supports and programs are listed as options, but with space to provide more details below.



Keyboard and Typing Settings

Test or Data Collection session:

The student types, using the recorded hardware setup and software supports. When the 'Done' button is hit, the site records typing rate in words per minute, including an accuracy percentage if for a copy typing exercise.

VOICE RECORDING

Voice Recording

Voice recording is by far the quickest, easiest and most intuitive method of independently recording information. When a child records their voice using a technology device, they are recording their speech. This is a voice file without text. Although the voice file can be transcribed at a later stage, this is specifically a function where the child is talking without having to think about the text on the screen. The reason this is such a powerful and quick method of recording information is that the child can talk, using a very simple record button, and say anything they want without having to be concerned about whether the words are showing up correctly, if the spelling is correct, and also without having to place any emphasis on specific grammar or any of the other conventions for writing.

Voice recording is one of the most powerful and yet one of the most underutilized methods for children to show what they know. Although this is not traditionally considered 'writing', it is one of the methods in which students can quickly become independent and show what they know, without relying on another person or on an adult scribing for them.

Voice recording can be a prewriting strategy in itself. It can be an excellent brainstorming, discussion and thinking tool, students just press the "record" button and then talk. But apart from brainstorming, it can also be an effective writing tool. Students can still participate in all of the prewriting strategies, discussions and information gathering before writing, and then use voice recording as an actual method of writing.

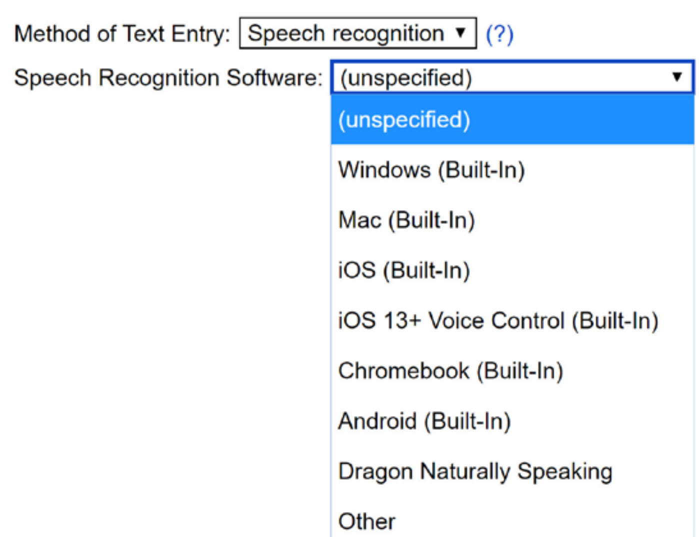
The student's recorded voice is transcribed in the background. As the student is talking, they do not see anything happening on the screen. This is by design since the aim is for the student to only be thinking about what they are wanting to write or record. Once the recording is done, and the student hits the "done" button, the voice recording is saved on the website and then is transcribed into text in the background. The teacher or therapist has access to the student's actual voice recording, as well as to the transcribed text. The adult has the option of editing the text in places that the transcription may not have been accurate. However, the website will calculate a words per minute of voice recording speed.

There are many hardware and software options available to students for multimedia-based voice recording, audio and video activities which can be fun and effective to show what they know. Students can participate in activities using a very wide variety of these voice activities, while still recording the voice on the assessment website, which then becomes part of the data of writing methods for that student.

SPEECH RECOGNITION

Child using Speech Recognition for Writing

If speech recognition is selected, these variables are provided.



Speech Recognition

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Test or Data Collection session:

With speech recognition, the student dictates using one of the speech recognition systems selected (shown above), and as they dictate, the text appears on the screen. The website records time (and accuracy for copying exercises). The student can see the text and has the option of editing the text and making corrections as they are dictating, if needed.

Differences between Voice Recording and Speech Recognition

Although with both of these input methods, the student is dictating or using their voice, they are very different processes.

Voice recording is an extremely simple technology. In most cases all the student needs to do is hit the "Record" button and start talking. All students of all ages and cognitive levels, even those with emergent verbal skills and those using augmentative communication devices to talk, can use voice recording very successfully for prewriting strategies as well as for writing.

Speech recognition is a much more complex process cognitively as well as in terms of reading and writing. Although speech recognition has become widely available, and in many cases free, and accuracy has improved enormously, it can still be a challenging process for some students. Students watch the text appear as they dictate, and they need a complex set of skills for reading and editing the text as they are dictating. Providing a speech recognition system does not automatically help students become good writers, however, it can be a powerful tool, and when used within a structured and well-planned approach, it can be highly beneficial for some students.

STUDENT WORK SAMPLES

The following are work samples from one student, prior to a full evaluation for assistive technology needs. Note the difference in speed, content and complexity of writing given different writing methods.

Grade: 9th

Speed in words per minute

Typing = 9 words per minute
Voice Recording = 105 words per minute
Speech Recognition = 21 words per minute

TYPING

The grat wall of China was bilt by the emper Cin. The wall was to protick the china pepar

From the Mogole invaters the best hous back army that ever existed. The grat Wall of china tuck bilyens of lives to belled and miluns war killed.

5 min 6 words ~9wpm

VOICE RECORDING

(Student recorded this information with no support or prewriting strategies)

LINK to audio file - https://www.closingthegap.com/media/fprmedia/china.mp3

The Great Wall of China was built to protect the Chinese from the Mongol invasions during the Ching dynasty. The wall stretches from the Northeast coast of China 2000 miles to the Southwest coast. The wall took billions of people to build but it cost over a million lives in deaths. The wall is built is a single wall that covers the whole fences of China. There was originally a series of smaller walls going all over China. The wall, 2000 years later, is falling apart because of erosion and neglection. The wall of China is an international symbol on foods and company symbols. The Mongols are the greatest horseback riders that ever existed. The wall is not build right on the border of China but in of the border at least on the modern border.

77.01 seconds 135 words ~105wpm

SPEECH RECOGNITION

Dictated using speech recognition (15 minutes after initial voice enrollment) with assistance for corrections:

The Great Wall of China. It was built in the Ching Dynasty. The wall was built to protect the Chinese people from the Mongol invaders. The Great Wall of China took billions of people to build and millions died. The Great Wall of China took 14 years to build. The Great Wall of China 2000 years later is falling apart because the wall is being neglected and of tourists. A Great Wall of China was built from the north east coast to the southwest coast stretching 2000 miles. There was originally a series of walls. The Great Wall of China took 14 years to build the Mongol invaders were the greatest cavalry Army ever.

5 min 43 seconds 114 words ~21wpm

OTHER VARIABLES

There are many considerations and variables to record as we set students up with writing exercises.

Other sections and variables to document are:

Prewriting Strategies or Activities:

- ☐ Brainstorming
- ☐ Mind map
- ☐ Outlines
- ☐ Discussion
- ☐ Watching videos
- ☐ Voice recording
- ☐ Audio books or audio information
- ☐ Drawing / annotation

Other Prewriting Strategies or Activities:

Prewriting Strategies or Activities

Prewriting Strategies or Activities

Planning and prewriting activities can make a significant difference for the student's writing. The type of prewriting activities should be carefully planned and documented prior to the data collection writing activity. If any online maps or outlines are created, or if a student watched a video online, the website or URL can be recorded here. Details about the type of prewriting strategies should be recorded.

Example of Flexible Positioning

Seating and Positioning

Students need a wide range of options in their environment for seating and positioning while working. Clearly, the range of options will be dependent on the type of writing they are doing. If they are handwriting on a page, then the requirements for posture and positioning are very specific and different than if they were voice recording on a handheld device. Writing production and speed, as well as volume of writing produced might be impacted by the student's positioning while working. Some

Another Example of Flexible Positioning

Positioning Supports:

- ☐ Height adjustable table
- ☐ Inflatable wedge for seating
- ☐ Memory foam wedge for seating
- ☐ Flexible or alternate positioning
- ☐ Adjustable keyboard mount or tray (angle and/or height)
- ☐ Wrist rest
- ☐ Arm support
- ☐ Keyguard
- ☐ Keycaps

Other Positioning Supports:

Seating and Positioning

teachers offer flexible positioning options. Classrooms are moving away from rows of desks and the same chairs for every student. This is a significant benefit for students. There are many considerations and the options and possibilities are different depending on the teacher, classroom, ages and needs. On this website, the option is provided for recording the type of positioning and set up for each writing exercise. If the student is typing on a keyboard or writing on a page they may need more structure and support, and if they are voice recording on a handheld device, they may be able to curl up on a beanbag, lie on the floor or sit outside under a tree while brainstorming or talking out their ideas. These are very different types of writing experiences, but they are all different ways of recording information.

Software Supports

There are infinite options when it comes to software supports and combinations of software settings and options, including hundreds of different programs available to help support typing, rate enhancement programs, spelling assist programs and many others. There are hundreds of programs that allow for voice recording, multimedia video production and content creation. In the last year, there has been an explosion of new speech recognition programs. The sheer volume and ever-growing list of software options is enormous. Sifting through these programs and options is a challenging job. We need to narrow the list of

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Software Supports:

Size and Contrast:

- ☐ Englarged font
- ☐ High contrast colors or theme
- ☐ Englarged mouse pointer
- ☐ High contrast mouse pointer
- ☐ Englarged text entry cursor
- ☐ Zoom display or magnification
- ☐ Hover text
- ☐ Dark mode

Keyboard and Typing Settings:

- ☐ Sticky keys
- ☐ Word prediction or predictive text
- ☐ Filter keys / slow keys
- ☐ Word completion
- ☐ Toggle keys
- ☐ Word bars and lists
- ☐ Abbreviation expansion
- ☐ Touch accommodations
- ☐ Grammar and spell assist
- ☐ Auto text (capitalization, punctuation)

Speech Output / Text to Speech:

- ☐ Speak letter
- ☐ Speak sentence
- ☐ Speak word

Additional Details About Software Supports:

Software Supports

many options in determining the types of tools, features, and settings that might be beneficial for individual students. We also need to document the tools, settings and options used in each writing exercise data point. This section allows the educator to record some of the more common software supports or to provide additional details about software and settings.

Data Collection Over Time

The Online Assessment of Writing Methods website can give a snapshot in time with one evaluation or data point, for a one-time evaluation. However, if used over time, with multiple trials of writing technologies and strategies, the data can provide valuable information on the following questions:

- Is this the right tool or technology for this student?
- Are the settings in the software correct, or does the student perform more efficiently with different settings?
- Are our training strategies, approaches and methods working?
- What kinds of pre-writing strategies make the most difference?
- Are there other strategies that help students with significant needs – for example, do some sensory calming strategies prior to writing have an impact on the students writing?

Online Assessment of Writing - YouTube link: https://www.youtube.com/watch?v=9s5hXZub_fM

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- Do certain postures or positions make a difference? Are flexible seating and options for alternate positions worthwhile?
- Do visual accommodations and modifications make a difference in the child's written output?

And many other questions…

As you collect data with very specific variables, you will start seeing trends and ongoing decision making can be based on the student's own real data. Graphs can be saved and printed, giving comparisons of different test setups. Many reporting options give options for data to be displayed based on the questions and the need for comparing progress over time and comparing performance with different methods.

SUMMARY

Writing is complex for all students. Evaluation and training of writing skills should not be a hit-and-miss process. As educators and parents, we should provide our students with a carefully planned, structured and detailed approach to helping them develop effective, efficient and independent writing skills. Children should use a wide range of methods and multimedia tools to write and to show what they know, to record or write what they think and to independently record their opinions and ideas. As students participate in trials of various tools and systems for writing, it is important to collect data about writing methods as well as all the variables and options for each writing exercise. This includes seating and positioning, environmental variables, software supports and settings and many more aspects of each writing exercise.

The Online Assessment of Writing Methods at typingtraining.com/writing_methods.html provides an online tool for comprehensive quantitative and qualitative data collection for individual students and groups of students. It can be used for all students using all technology tools and methods of writing. It can be used for individual students or groups of students. This data can be valuable in assisting teams and administrators in making decisions relating to systems, strategies and technology tools which are the most beneficial for their students to help them reach their full potential in writing. ■

For more information go to:
https://www.powerofatech.info/data-collection

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Emergent Literacy

We need to teach literacy to all of our students, including those with the most significant disabilities. We hear this message in professional learning and see it across our social media feeds. We overflow conference sessions describing the routines of emergent literacy instruction. Thousands of us have joined study groups for the new book from Karen Erickson and David Koppenhaver, Comprehensive Literacy for All. The book is a remarkably accessible description of the instructional routines necessary to meet the literacy learning needs of our students. It also describes the modifications, accommodations and explicit lessons that might be required to ensure this instruction is accessible for the range of disabilities our students face.

Our field has never known more about how to make our literacy instruction effective, engaging and relevant than we do now. It feels like the launch of a literacy revolution for students with significant disabilities and complex communication needs.

At the same time, however, many of us are attempting to share all this learning with educators who are new to the emergent literacy instructional framework. These instructional routines are familiar to early childhood educators, but may be completely novel to many special educators and secondary teachers. Our teams might struggle with new terms for tools like alternate pencils, or remembering which routines are emergent vs conventional. We might be stymied trying to integrate new routines with our old literacy programs and practices. Our colleagues may be wrestling with questions about whether all students can truly become literate. We might face headwinds in our schools where terms like 'reading instruction' can mean a lot of different things to a lot of people. We might be working in a school that mandates we use a specific literacy curriculum. We might miss the forest of comprehensive literacy for the trees of specific tools or interventions. What to do?

This article describes a simple framework to understand emergent literacy instruction. It is intended to help you break down and share expert knowledge with the front-line staff in your buildings, districts or individual education plan (IEP) teams. It should help you demystify new terms and frame the work of literacy instruction for your colleagues. It is intended to make emergent literacy instruction feel less intimidating and more doable. I developed this simple big-picture frame to make the details of specific interventions more accessible to the teams I support. It is not meant to replace the evidence-based interventions of comprehensive instruction. But it might help you focus attention on the big picture of quality emergent literacy instruction.

EMERGENT LITERACY

First, let's clarify what is meant by emergent literacy instruction. Emergent literacy instruction develops the understandings and behaviors that lay the foundation for conventional reading and writing. These are the understandings and behaviors that children without disabilities learn almost incidentally while growing up in households surrounded by models of speaking, reading and writing. Babies are exposed to the sounds of their language before birth. Infants engage in playful back-and-forth exchanges with caregivers long before they have language to express words. Small children witness speech directed at them and around them, while observing adults use tools like key-

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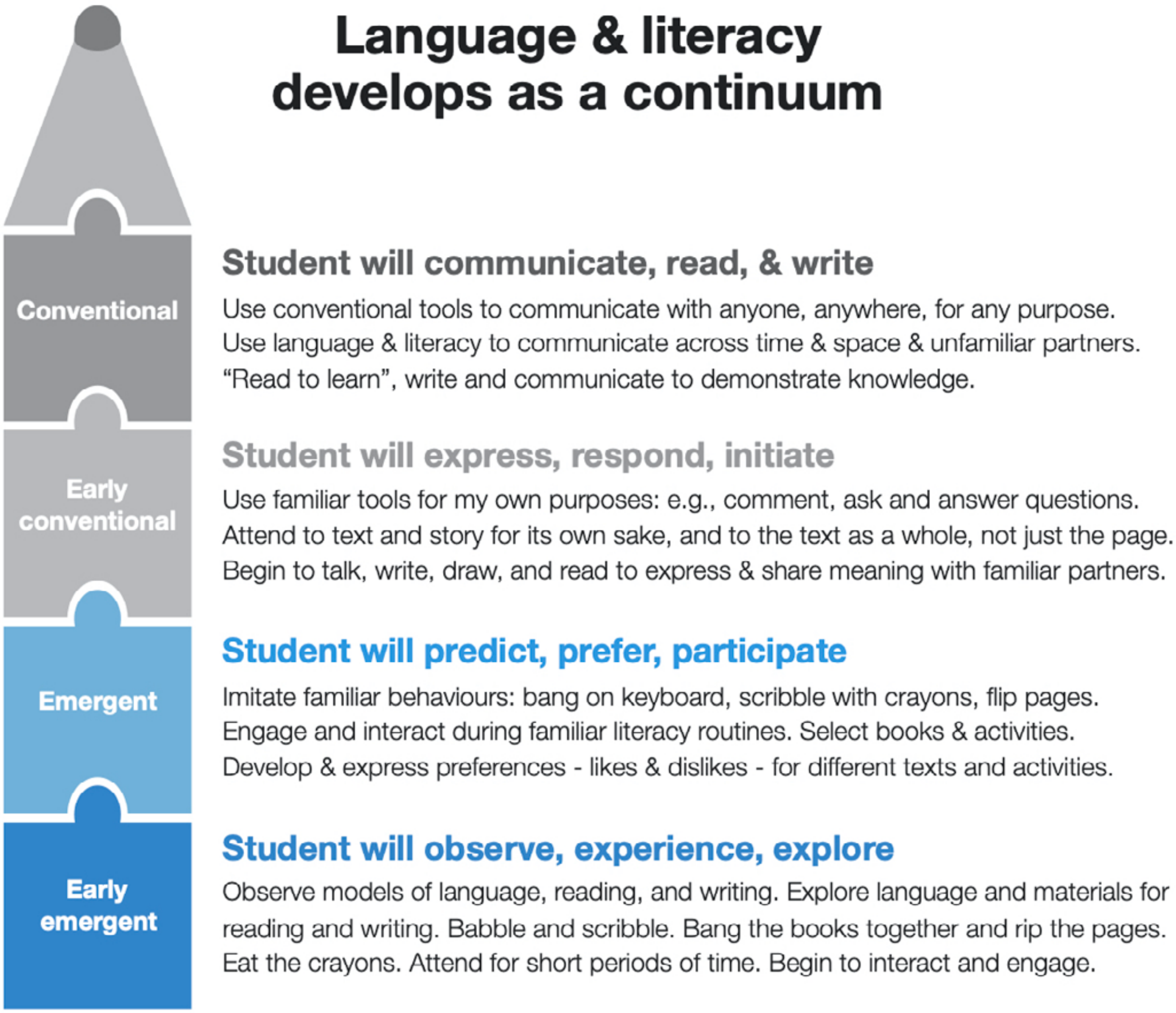

Figure 1: Language & literacy develops as a continuum

boards, books, smart phones, pen and paper. Adults engineer learning opportunities for young children by providing access to the tools of reading and writing with storybooks and crayons. Preschoolers learn the routines of listening to and responding to storybooks. They proudly contribute to the text around them, sharing their drawings and scribbles. By the time most children begin school, they know the letters of the alphabet and the role of books, writing tools, words and speech. They may not know how to spell legible text or decode words, but they are ready for conventional instruction that will allow them to communicate, read and write with anyone who knows their language.

Emergent literacy development is the accumulation of all those rich experiences with words and texts, from infancy to school age. These emergent experiences prepare and motivate children for the rigours of conventional instruction.

But many of our students with significant disabilities missed these rich experiences. If they could not speak, they may have never engaged in joyful back-and-forth exchanges with a caregiver. They may have never seen others use language in a way the student could participate, such as by modelling an AAC system. Their attention to storybooks may have appeared fleeting, and their exploration of books may have seemed random or destructive. They may have physically struggled to handle books or writing tools. If their vision or visual processing was impaired, they may have never witnessed the reading and writing occurring all around them. Our students with significant disabilities need the most explicit and intensive experiences with language and literacy, but they may arrive at school with the least. Our literacy and language instruction must build access to the foundational experiences and opportunities these students have missed. Comprehensive emergent literacy instruction fills in these gaps.

How do you know if your students are still emergent in their understandings of literacy? Just watch them. What a student

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knows about language and literacy can usually be observed and described. The continuum of literacy understandings is illustrated in Figure 1. Our **early emergent** students are still learning what language and the tools of literacy are all about. They may bang books together, chew the crayons, or ignore the symbol display. They may only engage with a page or two of a book, or a letter or two of a keyboard, before appearing to lose interest. They may have motor disabilities that have prevented them from physically exploring books or writing tools. Early emergent students communicate in ways that are idiosyncratic. As caring adults, we interpret their behavior to infer their feelings and preferences, then show them ways they could express their message with AAC. Early emergent students need frequent, predictable instruction that demonstrates the purpose of these tools, using formats that are accessible to them. Our job is to entice these students to observe us and interact with us as we use language and text. Daily emergent literacy routines allow them to make sense of these tools and experiences, and their role within them. We know our students are making progress when they engage with us with a favorite book, select a graphic symbol or a string of letters. These behaviors demonstrate their growing familiarity with literacy routines, tools and behaviors.

Emergent students are learning to participate in common routines like reading a storybook with us. They can predict what is happening. They have an idea what is expected of them when we sit down to read a book, draw a picture or point to a symbol while we talk. They observe us select letters and symbols to express ideas, but they are just learning to use symbols or letters or words themselves. Their early communication with symbols is inconsistent and often inaccurate or difficult to interpret. But we have piqued their curiosity and demonstrated these tools have meaning and relevance. Our emergent students are developing preferences, such as favorite books, activities or reading partners. Our job is to expand on those preferences and support these emergent students to actively participate with language and literacy. We know they are making progress when we see them initiating communication, interacting with us with books and directing how we read with them and exploring the alphabet to generate text.

Early conventional students are demonstrating consistency, such as readily participating and contributing in language and literacy routines. They might know the names of most letters but are still learning how they represent sounds in words. They are attending to a complete text and not just to page-by-page interactions. They are initiating communication around different activities. Familiar partners can interpret their messages, using context to fill in gaps in the student's message. Slowly, they begin to use tools like AAC and the alphabet to demonstrate what they understand. Traditional, conventional literacy instruction will teach these students the conventions of spelling, reading comprehension, decoding, and syntax, like word order and grammar. It is only when their skills are conventional that these students can be understood by complete strangers. **Conventional** students have learned the knowledge and skills of how we use words and text to communicate. But conventional instruction will only be inappropriate after a rich foundation of emergent literacy experiences has been laid.

With conventional skills, our students can read to learn about any topic. They can be known and understood by anyone they choose. The goal of comprehensive emergent literacy instruction is to move our students towards conventional literacy.

COMPREHENSIVE EMERGENT LITERACY INSTRUCTION

Erickson (2017) identified six instructional routines that encompass comprehensive emergent literacy instruction. Comprehensive instruction addresses all of the elements necessary for students to read with comprehension and write to convey thinking. These routines include:

- Access to AAC, demonstrated and used by others, all day, every day.
- Shared reading: a more skilled other scaffolds engagement with text.
- Shared writing: co-construction of text, when a more skilled other scaffolds the process of developing an idea that is then represented in print.
- Alphabet instruction and phonological awareness: learning the name and forms of each letter and the most common sounds they represent.
- Independent reading: students apply their knowledge of books to independently handle and engage with texts.
- Independent writing: students apply their knowledge of the alphabet to independently generate text.

With the exception of AAC modelling, each of these instructional routines is likely familiar to early childhood educators. Details on how to best implement each of these routines can be found in sources listed at the end of this article. The purpose of the remainder of this article is to reassure any educator who is overwhelmed by the idea of adding six new routines (and their accompanying new terms and tools) to their classroom repertoire. While each of these routines has unique value as specific literacy interventions, they share much in common. Embedded in each of these routines is a common flow of interactions between educators and our students. This flow helps structure a set of experiences that our students require to build a foundation of literacy. As we're learning to implement the routines of comprehensive emergent literacy instruction, it may be helpful to focus on the big picture of this flow of interaction. Over time, we can refine our practice, adding more detail and precision to each individual routine.

THE CYCLE OF EMERGENT LITERACY INSTRUCTION

The cycle of emergent literacy instruction is an explicit approach to literacy and language instruction. The cycle illustrates the common flow of interaction between educators and

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Figure 2: The cycle of emergent literacy instruction

students that is embedded within the instructional routines of comprehensive emergent literacy instruction.

Attending to this flow of interaction helps us focus on the 'forest' of building a foundation of language and literacy. The cycle helps us extend our literacy instruction across the school day, and distribute that instruction even into non instructional time. Attending to the cycle maximizes our opportunities to develop language. Reading, writing and communication are not just for the literacy block! See Figure 2.

TEACH

Emergent literacy understandings are fostered during interactions about interesting topics. The literacy block is a natural opportunity to teach a range of topics, from curricular content to the things and activities our students most enjoy. Literacy is how we talk and share about what we are interested in. 'Teach' might sound self-evident, but it is a reminder not to provide our literacy instruction in isolation from all the things our students care about and are learning about.

Literacy experiences are an important part of how we acquire the language that supports our thinking. When we read, write and talk about a topic, we form stronger mental representations of the topic or concept itself. Many of our students need explicit, intense support to build strong mental representations of abstract concepts. Literacy instruction is the vehicle to support our students' conceptual understanding of any given topic. Our instructional routines stay predictable and routine, but our different topics provide constant variety and interest.

EXPERIENCE

Our students need multi-sensory experiences to support their learning about any given topic. 'Experience' ensures that we are combining language with something tangible. Consider how to incorporate movement or sensation, including something to see, touch, hear or taste. The goal is that all students have opportunities to perceive and experience what we are teaching.

Literacy embeds language in experience. It transforms activities into knowledge, by providing language that deepens and broadens how we think and remember. Experiences give us something worth the effort of talking, writing and reading.

I visited a classroom last December that was deep into experiencing all the best of what the holidays had to offer. The students were cooking holiday feasts, taste-testing treats, attending special performances, listening to music, crafting gifts and watching holiday movies. The teacher apologized that they had put their literacy instruction on hold during that final busy week before winter break. This is a symptom of what I call the 'kale theory' of literacy. It's when we know literacy is important, but we haven't integrated it into our regular or special activities. This classroom reflected how easy it is to isolate literacy from experience. All those fabulous holiday activities were the perfect topics to read, write and talk about! The foods we like and do not like, the

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movies we love, what we see and do: all of these experiences are what we share through language. A focus on literacy as the vehicle to encode those fun experiences into memory could have turned these activities into rich and meaningful instruction. This classroom missed the opportunity to make December the richest month for literacy, rather than the most impoverished.

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SHOW

As we plan rich experiences to teach important concepts, we show our students how they can talk and write about what we are doing. If our students have complex communication needs, then we show them how to do this using their AAC. We demonstrate the use of their AAC, such as how we decide which symbols to select to express different messages. AAC needs to be modelled all day, every day. When we want to use a word that is not available in their AAC, then we show our students how we can spell the word with the symbol set of the alphabet.

We make AAC personal and meaningful by attributing meaning to what our students express. If they smiled and laughed during a performance, then we show them how we can use AAC to say we LIKED it. If they covered their ears and turned away, then we show them how they could complain we did NOT LIKE it. When in doubt, we use AAC to reflect what we see our students expressing.

Students who cannot speak will never have an AAC system that contains every word they might want to use. There are simply too many words in the English language to cram them all into a functional AAC system. This is where the symbol set of the alphabet is the most powerful. We can show our students how to spell the words they are missing. We can demonstrate this whenever we have a message to write. For our most emergent students, we might only show how we identified the first letter in the word we are seeking. We show our students as many letters as they will attend to us demonstrating. We make our thinking visible by sounding out the words and thinking-aloud, such as "I LIKE that! It is FANTASTIC! I hear an F, fantastic!"

INVITE

We've shown our students how they can talk about what we are experiencing. Now we invite our students to respond. They may choose to respond with multi-modal methods such as gestures or facial expressions, vocalizations, symbol use or even not at all.

We increase the likelihood of a response when we make our invitation as an open-ended comment, such as "I LIKED the performance. I wonder if YOU LIKED it, too." Now we wait for a response. We look expectant and curious, and we're prepared to wait as long as 30 seconds. Our emergent students need time to process what is expected, then consider and organize a response. If our students don't respond, we invite them again, such as by demonstrating another possible comment. "I saw you smile, I think you might have LIKED it." We wait expectantly again. If the student does not respond to this second invitation, then we move on. If they do respond, then we repeat their response and elaborate a bit more. For example, if, after our second invitation, the student smiles and laughs, then we might say "yeah, you LIKED it, too!"

Emergent students are still making sense of language experiences and literacy tools. They are still learning what their AAC does. They are discovering the joy of engaging, reading and writing. Our goal is not to get a "correct" response, because these students are still learning what language and literacy are all about. Instead, we set goals that our students will accept more invitations to participate, from more people, during more contexts. We prepare them for this success by showing them ways they can participate and maximizing the opportunities to do so.

WRITE

Writing is the process of encoding speech as written text. Our emergent students are learning that what we say can be written, and what is written can be read aloud. We make this process explicit by maximizing opportunities for our students to observe us as we generate text.

For example, after viewing a performance, we commented that we LIKED the performance and we showed our students they could comment as well. We might have reviewed photographs or video of the performance so that our topic is even more concrete. We invited our student to respond and she smiled and laughed in affirmation. When an emergent student accepts this invitation to respond, it is a tree that fell in the forest and the whole world needs to hear! We now create the opportunity for the student to observe us as we write down our co-created message: "We saw a holiday performance. We liked it!"

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While we write down the message, we draw attention to whatever part of writing feels most relevant to our student's current understandings. We might emphasize where we found specific letters on the keyboard or other alternate pencil. We might sound out a key word, emphasizing the initial letter or any key letter-sound relationship. We might emphasize the act of choosing an audience, such as saying. "I think your Mom would like to hear about the performance. Should we write her a note that we LIKED it?" This gives us the opportunity to sound out and spell a personally-meaningful word, such as "Mom."

Written work is published when it becomes something we can share. We can publish our writing on everything from a sticky note, to the home-school communication log, to a notebook we keep just for this purpose. We can send the co-created message as a text, email or social media post. We will often pair the text with a photo or other visual cue to help our student retrieve the memory and engage again with the text. Reducing the message to print allows us to demonstrate the power of print: it can now be easily shared with others. This has particular value for students with complex communication needs. The more effortful it is to generate a message, the more efficient it is to create written records that can be easily shared with many audiences.

READ

Our last step is to ensure that the text we generated is read by someone who finds it interesting. This might be another adult in the room, such as the special or general educator, a favorite therapist or paraprofessional. We might share the printed message with classmates, friends or peer tutors. We might save the message for when we encounter people walking in the hallway or when we visit the school nurse or front office. We might send the message home, supporting the family to create a routine of reading the student's messages aloud while sharing other family news. Families are often deeply interested in these communications. It gives them a window into their student's school experience and provides more ways for their student to join family conversations.

Some messages we write have only passing importance. Others can become stories that are read and shared with many people. Similarly, the messages we write with our students may be read only once, or may be worth "publishing" in a more durable format. We can turn these written messages into simple books by pairing the text with a photo or remnant. The most interesting messages we write together can become texts that will be popular in our classroom library.

What matters is that our students have frequent opportunities to observe that what we talk about can become print, and what we print can be read aloud and talked about some more. Emergent students are often more difficult to engage with commercial printed books. They are often most motivated by text with strong personal relevance, such as stories of their own lives. Developing routines to reduce our conversations to written text creates daily opportunities for students to take a more active role in sharing their stories, setting the topic of conversation and engage with personally meaningful text.

CONCLUSION

There are six instructional routines that, together, provide a comprehensive approach to emergent literacy instruction (Erickson, 2017). The cycle shared above highlights the flow of interactions that are common to all of these interventions. First, we ensure we are teaching topics and ideas of interest to our students, developing their conceptual understandings and ensuring they have things worth talking, reading and writing about. Next, we ensure that our instructional activities are hands-on and participatory, supporting all students to perceive and experience what we are learning. We then demonstrate the use of our students' AAC to talk about those experiences, so they can observe how their AAC system can share a range of messages and foster interaction. Next, we invite our students to respond and participate by sharing their own ideas. We generate written text about those experiences and responses, maximizing opportunities for our students to observe the process of speech as it is encoded to text. Finally, we look for opportunities to share that personally-meaningful text with new communication partners who read it with our student.

Adopting this flow of interaction is not a substitute for providing our students with the explicit, structured instruction they need to build their knowledge of language and literacy. But this cycle can help us remember the big picture. Language and literacy is the vehicle through which our students with significant disabilities can learn about the world, organize their thinking, share their experiences and express their own ideas. The cycle described above helps us extend our literacy instruction across the school day, getting us closer to the two hours per day of literacy instruction that Erickson and Koppenahver (2020) recommend. It helps distribute that instruction into non instructional time, giving us a framework to turn our experiences of school assemblies, special events, recess and the like into activities we can talk, write, and read about. In this way, we can all be part of the literacy revolution for students with significant disabilities.

ABBIE'S SECOND GRADE CLASS

Abbie sits in a small group with her second grade peers watching a video of the life cycle of a butterfly. Her AAC is in easy-reach. A duplicate of her AAC is available to her peers as well. The students are watching the video with the purpose of describing four vocabulary terms: egg, caterpillar, chrysalis, and butterfly.

After the video, the students use a simple graphic organizer - a concept map - to brainstorm words related to each vocabu-

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lary term. They refer back to the video or to a classroom text on butterflies to help them generate ideas. Abbie reaches out and touches the butterfly images on the page. Her classmates attribute meaning to what Abbie brings attention to, then generate words in response, such as "I think you are noticing that the butterfly is drinking. Let's write that down." As they collect words, they look through Abbie's AAC system to ensure she has those words available. If she doesn't, they try to re-state the word using terms she has available in her system. Their goal is to create definitions for each vocabulary term using words Abbie can use, too.

Once the students have finished brainstorming, they select the words they feel are the most descriptive. One of the students is learning to keyboard, and she types their sentences into a word processing document. The students use parter-assisted scanning to ask Abbie for her word selections. Abbie nods and vocalizes in response to "hungry," "growing", "changing," and "beautiful." Their completed sentences look like this:

Eggs are small.
Eggs are round.
Eggs are many!
Eggs become caterpillars.

Caterpillars are hungry.
Caterpillars are growing.
Caterpillars are moving.
Caterpillars become a chrysalis.

The chrysalis does not eat.
The chrysalis sleeps.
The chrysalis changes.
The chrysalis is growing wings.

The butterfly is coming out!
The butterfly is drinking.
The butterfly is flying.
The butterfly is beautiful.
The butterfly is laying eggs.

The paraprofessional supervises as the children copy and paste each sentence on to its own page of a slide making software. The students also paste each sentence into an image search on the internet. Abbie watches with anticipation as a selection of images appears with each search. She reaches out and selects an image for each sentence. The students copy and paste her choice of photos into each slide, sometimes lobbying her to select a particular image. Their simple book is finished before recess starts. The children proudly show off their book to their classroom teacher. Abbie tells her teacher "hungry beautiful" as she reviews their book. Her teacher grins and agrees, pointing to where those words appear in their new book. This classroom book is sure to be popular in the classroom library. Abbie's teacher knows from experience that Abbie will read the book, independently with technology or paired with classmates, for weeks to come.

See Sheldon & Erickson (2020) for more ideas about embedding comprehensive emergent literacy instruction in the regular classroom.

SOURCES:

Erickson, K. (2017). Comprehensive literacy instruction, interprofessional collaborative practice, and students with severe disabilities. American Journal of Speech-Language Pathology, 26, 193–205. doi: 10.1044/2017_AJSLP-15-0067

Erickson, K., & Koppenhaver, D. (2020). Comprehensive literacy for all: Teaching children with significant disabilities to read and write. Baltimore, MD: Brookes.

Sheldon, E. & Erickson, K. (2020). Emergent literacy instruction for students with significant disabilities in the regular classroom. Assistive Technology Outcomes and Benefits (14), in press.

FREE RESOURCES TO LEARN THE ROUTINES OF COMPREHENSIVE EMERGENT LITERACY INSTRUCTION:

Project Core, from the Center for Literacy and Disability Studies, includes 12 free professional learning modules on the instructional routines associated comprehensive emergent literacy instruction.

Literacy Instruction for Students with Significant Disabilities http://literacyforallinstruction.ca offers information, research-based instructional approaches, and effective instructional and learning strategies to support school leaders, teachers, and other specialists working to better meet the literacy and communication needs of students with significant disabilities, including students with moderate to severe cognitive disabilities, complex communication needs, and multiple disabilities including deaf/blindness and/or physical access challenges.

InclusionOntario, recorded webinars explaining the cycle of comprehensive emergent literacy instruction as it applied to each of the instructional routines. https://www.inclusionontario.ca/Emergent-Literacy.html. ■

Part 4 of 5

Children with Complex Communication Needs and Cerebral Visual Impairment: What's the complexity?

To date the series on providing emergent literacy instruction for children with significant disabilities, including cortical visual impairment (CVI), has introduced readers to comprehensive emergent literacy instruction (Hanser, Musselwhite, & Wagner, 2019a), one component of this instruction – predictable chart writing (Hanser, Musselwhite, & Wagner, 2019b), and setting the stage for augmentative communication (Wagner, Hanser, & Musselwhite, 2020). In this, the fourth installment in this series, the intention is to dive deeper into: the characteristics of children with both complex communication needs (CCN) and CVI are; the challenges they encounter in communication and language development; and the misconceptions that are emerging about representation of language for these children. Finally, case studies will be used to reinforce the need for Teachers of the Visually Impaired (TVIs) to be integral members of AAC teams for these children.

KATHY HOWERY received her PhD in Special Education from the University of Alberta in 2017 where she explored the lived experience of young people who speak with (or through) speech generating devices. She began her career over thirty years ago focusing on finding ways for students with the most complex needs share their voices in the world. From 2004 to 2008 she lead the Alberta Assistive Technology for Learning Initiative. Since that time she has developed and taught graduate level courses in Assistive Technology, Learning and Development, Special Education, Universal Design for Learning, and Augmentative and Alternative Communication. Kathy is the Alberta representative to ISAAC Canada and a past board member of the Alberta Chapter of the Council for Exceptional Children. In addition, she has held positions on the Inclusive Learning Network of the International Society of Technology in Education (ILN/ISTE), and on the leadership team of the Universal Design for Learning -Implementation Research Network (UDL-IRN). Currently, Kathy provides ongoing consultation to Alberta school jurisdictions in the areas of UDL, special education, and supporting children and youth with CCN in developing communication, language and literacy skills. Most recently Kathy is working under contract with Alberta Education as part of the Provincial Wide Low Incidence Collaborative Supports team with primary responsibility in the area of complex communication needs.

MAREN BARROS is a Teacher of the Visually Impaired and a CVI Endorsed Professional. She has been practicing in the field of visual impairments for 12 years, however having grown up with a brother who is blind, she regularly jokes that she has been in the field for much, much longer. These personal experiences have very much shaped the path of her career, starting off with a degree in Neuropsychology (trying to understand the development of visual perception but also the impact of trauma on the brain) and eventually led to the pursuit of both her B.Ed. and M.Ed. degrees. Her passion is working with students who have Neurological Visual Impairments and collaborating with team members in order to best meet their educational needs. She resides in Stony Plain, Alberta but travels widely as a consultant to serve this population of students.

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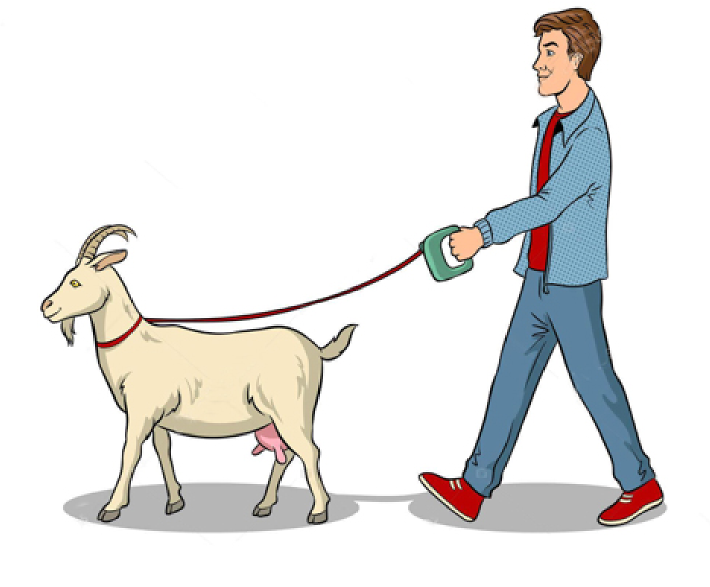

Image 1: A man walking a goat on a leash.

WHAT'S THE CHALLENGE?

The following short story provides as an example of the kinds of challenges people with CCN and CVI may encounter with the complexity of vision and language. It also highlights the fact that professionals may also struggle with these issues.

As indicated in previous articles, Tietjen (2019) suggests that the primary and most persistent educational impact of CVI often revolves around visual complexity. To illustrate this Tietjen, in his What's the Complexity Framework Course (2018) presents an image, similar to the one below, of a man walking a goat on a leash (Image 1).

The authors used this example when mentoring a speech language pathologist (SLP) who was working to support a young boy with CCN and CVI. What occurred was a unique opportunity to see and hear firsthand how tightly vision and language are interwoven, and how one's professional lens may impact one's interpretation of the child's challenge of vision, language or both.

The TVI was explaining the issue of visual complexity and the impact that CVI may have on a child's ability to correctly interpret visual information by sharing the goat on a leash image. The TVIs version of why a child with CVI might incorrectly say that the animal on the leash was a "dog" was due to their vision – they couldn't visually discern that the animal on the leash was a goat and therefore would go to their more general assumption that an animal on a leash would be a dog and therefore label it as such.

*The SLP to whom this issue of visual complexity was being explained replied, "Well if I had a child label that animal as a 'dog' I would have assumed it was because they didn't have the word "goat" in their lexicon (**vocabulary**) – that is: they didn't know what a 'goat' was and therefore called it a dog."*

Of course, both of those interpretations of the child's labeling of the goat as a dog could be correct. It may be a vision issue or it may be a language issue, or, as is often the case for child with CVI and CCN, it could be both. Therein lies the complexity for professionals – vision and language are intimately interconnected. Vision and language are perhaps most significantly interconnected for children and youth with CCN who are provided with AAC supports that privilege vision such as pictographic symbols or sign language. In order to provide the best access to communication and language development for these children, it is necessary to untangle the complexity of vision and language. This untangling will require professionals to step outside of our silos and work together in order to tease this relationship apart.

WHO ARE WE TALKING ABOUT?

The population of children who may benefit AAC to support communication and language development is commonly referred to as having CCN (Buekelman & Light, 2020; Light & McNaughton, 2011; Loncke, 2014). These children are "unable to communicate effectively using speech alone. They and their communication partners may benefit from using AAC methods, either temporarily or permanently. Hearing limitation is not the primary cause of complex communication need." (Perry et al., 2004, p. 261)

The "etiologies associated with CVI and CCN in children are often the same" (Blackstone & Roman, 2019, p. 65). While not all children with CCN also have CVI or vice versa, AAC professionals have long recognized that many children with CCN have problems with their vision. As many as 48 to 75% of children and adults with developmental delays and cerebral palsy and 75 to 90% of children with severe and profound cognitive disabilities demonstrate significant visual problems (Blackstone & Roman-Lantzy, 2018). According to Dutton & Bauer (2019) "40% of the brain serves vision, it is therefore highly likely that children with cerebral palsy and other major developmental dysfunctions, may have additional hidden visual difficulties" (p. 66). These vision difficulties may remain hidden "because affected children cannot describe them, or because the evident motor impairments have taken precedence. The default condition for all such children needs to be that they may have CVI, until proved otherwise, rather than the other way around" (Dutton & Bauer, 2019).

WHO ARE CHILDREN WITH CVI/VISION NEEDS?

***Any child who is not using their vision typically isn't seeing typically** - this can have major implications for their literacy and language development!*

In the February/March article of this series, Wagner, Hanser and Musselwhite defined CVI as a "neurological disorder which impacts the processing of visual information in the brain" (2020). To date, the articles of this series have used the term CVI in a broad sense, and have depended primarily on outcomes of the CVI Range Assessment to help the reader choose visually appropriate emergent literacy strategies.

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In Europe and other areas of the world, the common term to refer to a neurologically-based visual impairment is CVI. In North America, the term Cortical Visual Impairment is used to describe this same population of children; however, Roman-Lantzy (2019) argues that these two terms are not synonymous. She writes, "Cerebral visual impairment is a term used to describe a broad spectrum of visual processing disorders (Lueck and Dutton, 2015), whereas the term cortical visual impairment adheres to a stricter set of criteria that are associated with medical and educational visual impairment" (2019). The CVI Range Assessment is a tool that is designed very specifically for cortical visual impairment and is therefore not designed (nor appropriate) to be used with all children who have cerebral visual impairment.

As a practitioner, this is where things can appear to be quite complicated. Perhaps, as Wagner, Hanser and Musselwhite state, CVI is "frequently undiagnosed and unrecognized" (p. 31) because the field uses CVI to refer interchangeably to two different things. The question remains, how does one know which version of CVI we are seeing in the child?

GATHERING OUR INFORMATION: VISION

From a vision perspective, the TVI is charged with determining what and how a child sees, typically by conducting a Functional Vision Assessment (FVA). For children who have low vision as a result of an ocular visual impairment and who also have spoken language, standardized approaches (e.g., vision charts) can be used to good effect to obtain fairly accurate measures of acuity, contrast sensitivity, color vision and depth perception. On the other hand, when a child has CCN and limited expressive communication, these standardized approaches are ineffective and often impossible to use. Instead, the TVI must rely on other assessment skills and strategies in order to determine functional vision. For a child with significant disabilities, CCN and suspected CVI, the FVA might involve the following:

- Comprehensive medical/file review, documenting any/all known or commonly associated neurological risk factors for cerebral visual impairment.
- Assessment of ocular vision.
- Extensive interviewing with the parents and school-based team, beginning with a CVI screening tool such as the one that can be found at https://www.teachcvi.net. This tool will be especially valuable to teams where CVI is perhaps suspected but remains undiagnosed.
- In an ideal world, the TVI (or another team member) will have completed the CVI Range Endorsement offered by the Perkins School for the Blind (or at the very least had some additional professional development with this assessment tool). Someone with the CVI Endorsement has demonstrated that they can use this tool with fidelity. This is important because, as mentioned above, this tool is best used for a specific subset of children and someone with the Endorsement would likely know when it should be used and when it should not be used. As the other articles in this series have so articulately pointed out, this tool is built around 10 commonly seen characteristics, and the CVI Range tool eloquently maps out where the child is functioning across all 10 characteristics. With planned, sequenced intervention strategies, these characteristics can and often do improve over time in a fairly predictable way. This information can then be taken and applied directly to informing the best presentation of the child's literacy materials and the ideal format of their AAC system.

CCN AND THE PROVISION OF AAC

Successful implementation of AAC involves both the people with CCN and their communicative partner(s) (Perry et al., 2004). As the complexity of the disability increases, so does the complexity of communication needs and of finding appropriate AAC solutions, and "people with disabilities must also rely on the skills of others to help them to be a part of a conversation" (Iacono, 2014, p 83). Furthermore, provision of AAC supports and services for children and youth with CCN must not only provides a means by which they can communicate, but also provides a pathway to language development and language competence (von Tetzchner, 2017). We know that for all children, language learning is an active process that begins at birth (or before) and continues throughout life. Providing communication for every child is based on the foundational belief that **every child communicates and is capable of learning symbolic language** (Howery, 2017).

The field of AAC recognizes that children with CCN need access to representations of language (AAC) to support both their expressive and receptive language development. This means that they need to see their systems being modeled and used by others in order to develop their own communicative competence and growth in language (Dada & Alant, 2009; Harris & Reichle, 2004). And that modeling alone, while important may not be sufficient (Soto et al, 2020). In addition, there is a growing recognition that children and youth with CCN, no matter what the etiology, need access to a robust language system which somewhat simplistically may be thought of as meaning *at least* 100 words organized in an understandable, predictable manner (categorically, pragmatically or semantically) using a consistent and meaningful symbol system (Ahern, 2015). In order to communicate beyond the here and now, and to grow and use *language*, children with CCN must have access to enough words, in a well thought out system, in order to engage in all of the various functions of language (requesting, refusing, declaring, questions, commenting, etc).

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COMMUNICATION, LANGUAGE, AAC AND CVI

Blackstone and Roman- Lantzy (2019) state that children with CVI who need AAC have limited opportunities to explore robust AAC systems that contain vocabulary for commenting, protesting, questioning and communicating about their world. In addition, they quite importantly point out that vision is a key component of *visual joint attention*, and therefore children with CVI may fail to see a partner's pointing cues or any supplementary cues such as where a partner is looking. The consequence of this is that the child may clearly fail to see or even notice that their communication partner is modeling language on an AAC system where symbols are pictographic or visual (sign). However, there are other means of establishing joint attention, and not all AAC systems must be accessed visually. These and other issues may be impeding access to robust AAC for many children with CCN and CVI.

MYTHS AND MISCONCEPTIONS ABOUT CCN & CVI

Increasing access to AAC for children with CCN and CVI requires careful attention to a number of myths and misconceptions that professionals must grapple with across areas of expertise and interest.

SYMBOL HIERACHIES

The first misconception is an age old one for the field of AAC, but one that has thankfully been refuted. That is the idea that *children must start with real objects, then progress to photographs before we introduce graphic symbols.* In AAC this is called the "symbol hierarchy." It has been shown that it is unnecessary to follow the hierarchy (Romski & Sevcik, 2005), and it has also been asserted that it limits children's learning of language (von Tetzchner, 2015). While parents, teachers and therapists may attribute meaning to a graphic symbol because it is iconic (looks to us like what it is supposed to represent), youth with developmental disabilities and CCN can establish iconic and arbitrary symbol-referent relationships for symbols ***when given experience with them, regardless of the iconicity of the symbol*** (Romski & Sevcik, 1996; Sevcik, Barton-Hulsey, Romski & Hyatt Fonseca, 2018).

In other words, children don't recognize symbols, they LEARN them through repeated opportunity for understanding and use! For children with CCN and CVI, this must mean that the symbols are perceptible and distinguishable from one another. They must also contribute to learning over time. For example, learning that a photograph of a chair references an actual chair is only helpful if you want to reference the specific chair. Yet, we typically want children to understand that the symbol represents any chair – it is a symbol for chair or, potentially, sit. The concrete reference for the original, specific chair is relatively easy to teach to a child who can see both the chair and the photograph of the chair. However, children with CVI may need to learn to use their vision to see the chair, the photograph of a chair, and subsequent drawings or symbols representing chair. At the same time, they must learn to understand the concept of chair and its use in language.

While a visual hierarchy may help a child learn to use her vision to see what a chair is (e.g. first a real chair, then a different real chair, then perhaps a doll chair, a picture of a chair, a line drawing of a chair, and so on), **the symbol hierarchy is not necessary and is likely counterproductive when we are talking about language development and expressive communication using AAC.** As stated by Burkhart and Costello (2008), children with CVI require consistent and predictable opportunities to experience and manipulate language. Their language exposure and success should be built upon, but not dependent on, engaging vision.

HIGH CONTRAST SYMBOLS ARE BEST

A commonly held belief in the field of AAC is that children with CCN and CVI should be provided with so called "high contrast" symbols. Typically, these picture communication symbols are intentionally less complex in terms of detail in the image, highly saturated with bright color and placed against a black background. However, there is little evidence that these "high contrast" symbols are the best ones to use for children with CCN and CVI. It depends on the individual child. AAC professionals must depend on their TVI colleagues to help them provide children with CCN and CVI what all children need: symbols that represent language in a way that they can not only understand but use (Tomasello, 2003).

GATHERING OUR INFORMATION: COMMUNICATION AND LANGUAGE

In the article *Setting the Stage for Augmentative Communication*, Wanger, Hanser, and Musselwhite (2020) provide some guidance in terms of documenting how children with CCN and CVI are presently communicating. The form they present can be used to document what a child is doing as a communicative behavior, what that behavior/actions means (or what partners believe it to mean), what actions the partner(s) should take to respond to that behavior/act to support the child understanding its communicative power, and how the partner should respond both verbally (what to SAY) and in aided/augmented form (what to MODEL in their AAC modality).

While this is indeed a useful form, it is sometimes difficult for partners to identify exactly how they know what a child is communicating through their behavior(s) and to see how the child might be communicating for various functions. Three additional tools that may be helpful in identifying the child's present communicative behaviors:

- The Communication Matrix (Rowland, 2020)
- Pragmatics Profile (Dewart & Summers, 1995)
- Communication Signal Inventory (Cress, 2018)

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By working through these inventories with families and other familiar communication partners, a clearer picture can emerge as to how people "know" what it is the child is communicating, and a description of those behaviors can be developed for the "How I Communicate" Form. In addition, each of these tools can offer a present level of performance from which interventions can be designed, and through repeated measures communicative growth can be monitored and celebrated.

BRINGING THE TEAM TOGETHER

While thus far the emphasis has been on the need to include TVIs in decisions regarding AAC for children with CCN and CVI, this in no way diminishes the need for other team members such as Occupational Therapists (OTs), Physical Therapists (PTs) and educators (Erickson & Geist, 2016). Such a team is required to address ACCESS to communication modes with a focus on participation and language development. Physical and visual ACCESS to AAC must be explored from multiple perspectives in order to ensure the most efficient and effective means for children with CCN and CVI. This process involves documenting the child's motor skills (e.g., their ability to point with a finger, use eye-gaze, switches), other sensory skills (e.g., hearing) and the impact of impairments when they occur in combination. As Iacono (2014) so correctly points out, "such is the unfair nature of disability that they often come in multiples" (p. 83). Given that, the need for interdisciplinary methods and practices cannot be understated!

SO WHERE TO START? PUTTING THEORY INTO PRACTICE.

It should now be evident that an interdisciplinary approach is absolutely vital to this process. Each specialist has a specific and valuable lens and skill set. The following case examples are provided to illustrate how working together can result in unique recommendations of AAC supports for children with CCN and CVI.

Lance *is in Grade 1 who has WEST Syndrome, a neurological condition that causes a significant amount of ongoing seizure activity. He is non-ambulatory, has significant cerebral palsy and has no access to expressive spoken language other than a few sounds. The TVI completed a CVI Range assessment and found that he is in early Phase I (i.e., he is continuing to work on building consistent visual behavior). Over the previous two years, the score on his Range assessment has fluctuated between 1 and 2.5, with regular "setbacks" occurring because of his seizures. This fluctuation and ongoing work to build visual skills suggests that he is not going to be able to directly access graphic symbols. Therefore, the team chose* **to privilege auditory information**. *Before finalizing this decision, they ensured that his hearing was adequate. When it is determined that this his hearing was adequate, they proceeded with implementing a system that allows for* **partner assisted auditory scanning**, *in this case, an alternative access Pragmatic Organizational Dynamic Display (PODD). Two PODD books were created, one for Lance to use expressively and one with high contrast visual symbols, reduced display size and tear off high contrast symbols that will be used by communication partners to support Lance's receptive language. This system supports auditory scanning while also leaving open the possibility of continued visual development through* **greatly reduced visual complexity of the array itself and careful use of colour and contrast.** *In addition to this, the team is using Linda Burkhart's "stepping stones to switch access" (Burkhart, 2018) to help guide them in teaching Lance to access switches that he might use for more independent and autonomous access in the future.*

Jody *is a student in Grade 8 who has a chromosomal deletion. She arrived at her new school with a high-tech eye gaze system intended to support access to AAC. Unfortunately, she has not been very successful in using the system. She has no diagnosis of CVI or even any documented visual impairment in her extensive school file; however, she does have a known moderate-severe hearing loss. She is non-ambulatory but has fairly good use of her hands. The TVI, who is CVI Range Endorsed, was slightly shocked to discover that Jody demonstrates CVI on the CVI Range. She is in Phase II on the Range (with a score of 6) and is beginning to more consistently integrate vision with function, and* **movement** *seems to activate and captivate her visual attention. The team decides to try and implement Makaton® (***simplified sign***) and continue to practice with the eye gaze system but with an emphasis on play-based activities that might support her vision development and use of eye-gaze over time.*

Miriam *is a preschool student who has been diagnosed with Autism Spectrum Disorder (ASD). She is very active and visually curious about the world around her. She often prefers to travel quite quickly in her environment, even though she is fairly clumsy and falls down often. She loves shiny objects, bubbles and things that move. The preschool team had been attempting to implement AAC support offering her four symbols at a time on an AAC app on an iPad, Miriam was not at all interested in this app, instead she insisted upon running up to the large, low-tech core board display that they had posted on the wall of the classroom. Despite the apparent increased complexity the core board presented, Miriam indicated this set up was more appealing and engaging than the four location set that changed for every activity. The consistent location of the symbols appeared to be helpful. When considering the appropriate AAC system for such students then, we would do well to explore* **privileging motor planning** *and the selection a system that incorporates* **consistency of array**. *In Miriam's case, based on her apparent preference, LAMP was selected for trial.*

**Note: This does not mean that a highly complex visual display is*

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appropriate for all students with ASD! In the author's experience, it is possible that highly complex displays are not accessible to every student with an ASD diagnosis and quite often the students are unable to interact with them using a visually guided reach.

FINAL THOUGHTS

Information gathered from various disciplines should inform interventions for children and youth with CCN and CVI. Care should be taken to understand the combined impact of communication, vision, motor and other sensory impairments. Furthermore, teams should take care to move beyond myths and misconceptions that are negatively impacting access to AAC for many children with CCN and CVI. Working outside of professional silos will help reduce barriers and help address the fact that, at least not at the present time, there is NO COOKBOOK approach to AAC intervention for children with CCN and CVI. Ongoing, DYNAMIC assessment involving professionals from various disciplines and a range of assessment tools is the only answer.

"It is essential that vision and communication therapies be integrated and that visual specialists, speech-language pathologists, and other professionals work collaboratively with family members to increase the child's ability to use his or her functional vision so he or she can access language, communication and participate." (Blackstone & Roman, 2019)

Yes, AND,

"It is essential that visual specialists, speech-language pathologists, and other professionals work collaboratively with family members to help children develop language so that they can understand (put words to) and express (talk about) what they are seeing" (Howery, 2019).

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product spotlight

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PAIR & PLAY

Tap does not require any software drivers – it is a plug-and-play Bluetooth input device that works with everything from phones to tablets, Laptops & SmartTV's.

Tap works with all of the popular operating systems such as iOS, Android, Windows, Mac & Linux.

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FULLY CUSTOMIZABLE

The TapMapper tool lets you create, save and share custom maps. You can type in any language, trigger hotkeys and build custom macros. You can download thousands of TapMaps created by users, and upload and share your own Maps.

AIR GESTURES

The new Tap Strap 2 adds an AirMouse Mode, allowing clicking and cursor control just by pointing a finger, and allows virtual swiping on mobile devices. AirMouse can also be used to control media, and navigate menus.

HOW TAP WORKS

Wow, It Really Works!

Over the past 2 years, they have exhibited and sold the Tap Strap at trade shows and conferences around the world, from MWC in Barcelona to SXSW in Austin. They have shown Tap to tens of thousands of people – and have a growing community of active users around the world. At every show, attendees crowd around, waiting their turn to try out this new technology. "Wow, this is amazing!", "This is the coolest thing in the whole show!, "This is definitely the keyboard of the future", "If I didn't try it myself, I wouldn't believe that it works."

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TONGUE BASED OPERATING SYSTEM

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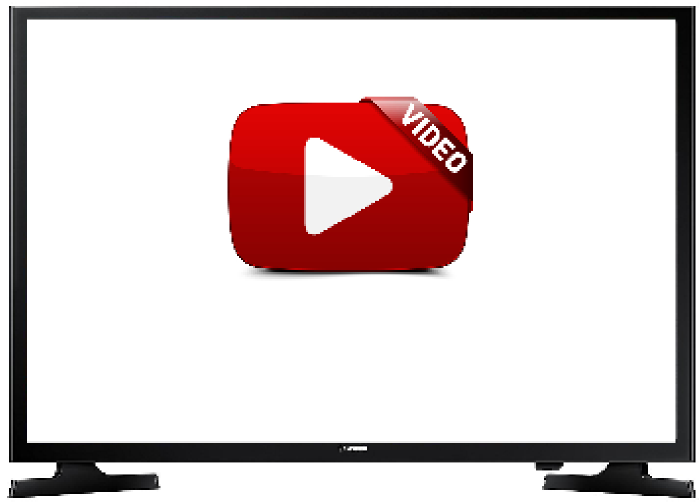

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Ease Apps – Easing the Accessibility to the Smartphone!

WHAT IS EASE APPS?

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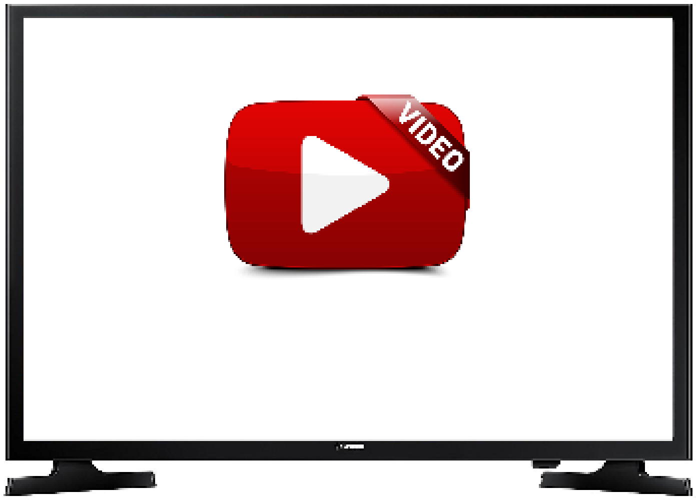
Ease Apps was born to provide an answer to the lack of physical accessibility of mobile devices, the so called smartphones and tablets.



WHO IS DESIGNED EASE APPS FOR?

They want everyone to be able to interact and communicate using a mobile device themselves.

CEREBRAL PALSY

For people with traumatic brain injuries or cerebral palsy, with ataxia or other conditions.

MULTIPLE SCLEROSIS

For people with multiple sclerosis or other neuromuscular diseases.

PARKINSON'S

For people suffering from Parkinson's or essential tremors.

MANIPULATION PROBLEMS

In general, for people with difficulties to access the touch screen or for alternative access through all kinds of mice, switches or game devices.

RELATIVES AND SUPPORTERS

Ease Apps are also aimed at relatives of people with disabilities and social and health care professionals, looking for solutions to reinforce autonomy and facilitate interaction.

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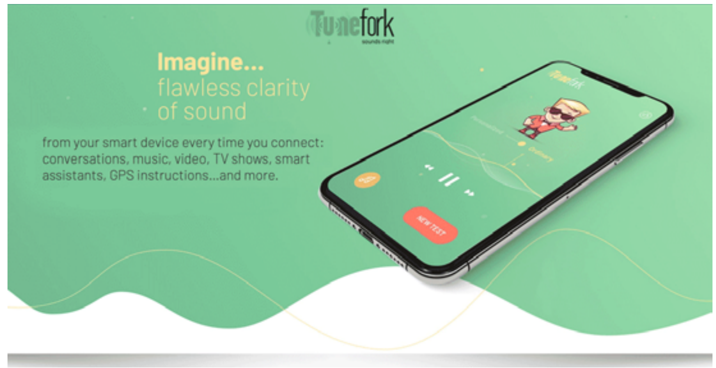
TuneFork – Flawless Clarity of Sound



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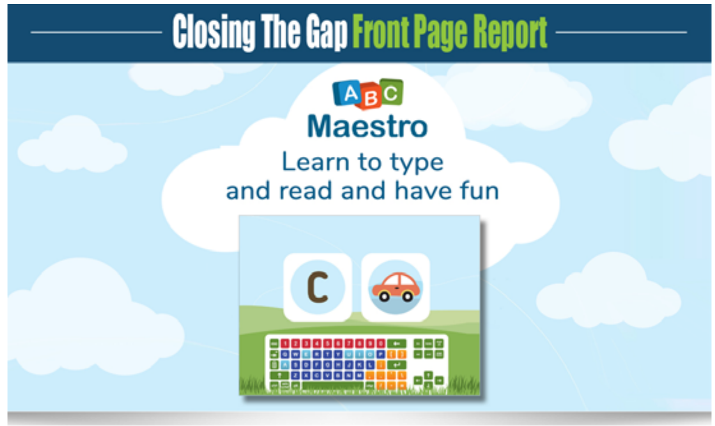

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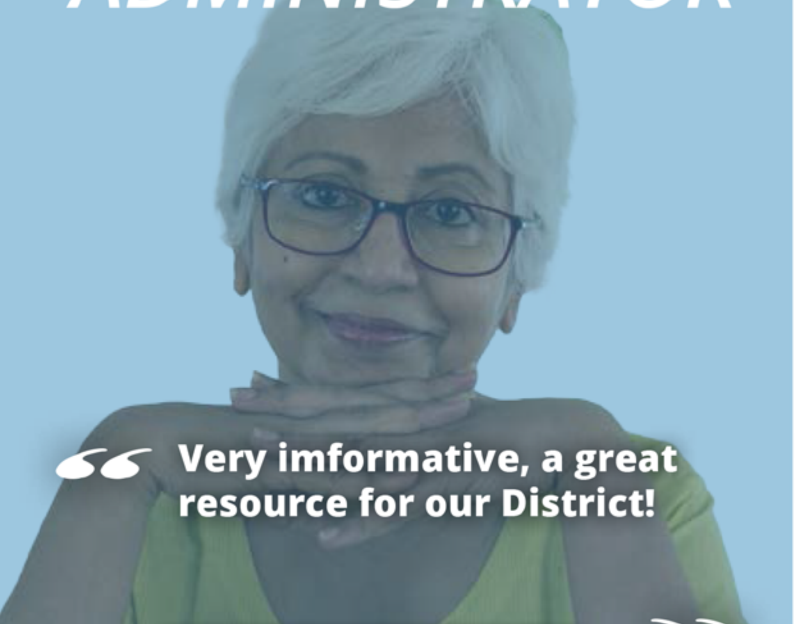

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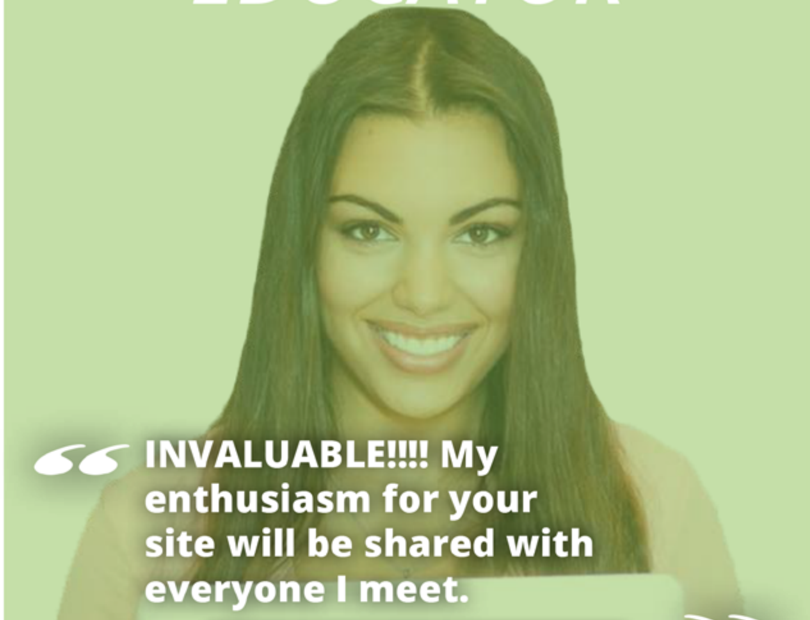

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