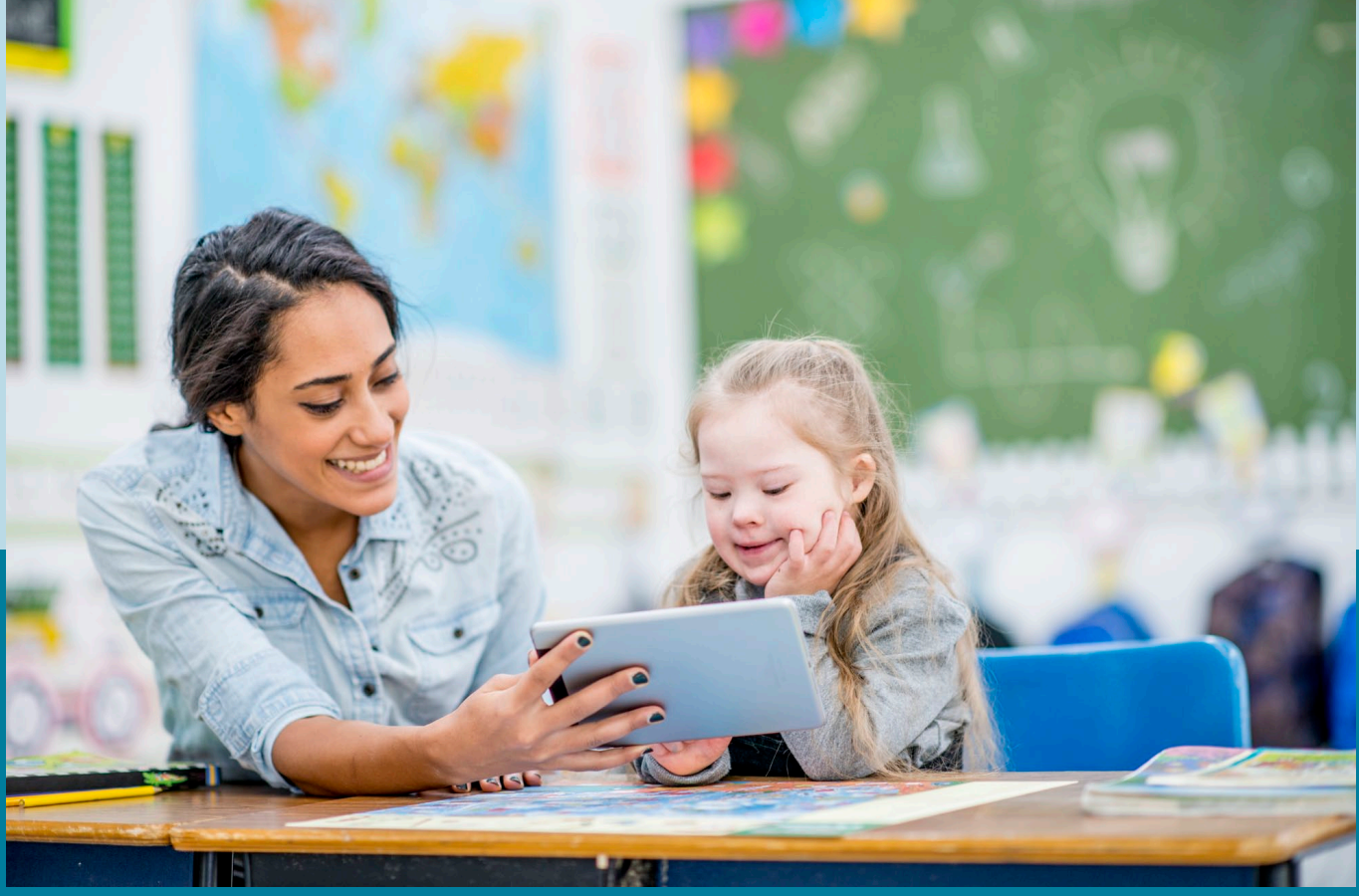

Improving Engagement

Integrating Assistive Technology in Early Literacy

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In the 21st century, there has been an explosion of technological advances and integration of technology in all aspects of life where people learn, work, and play (Flewitt et al., 2015). Young children live in a world permeated by the presence of technology (Hilaire & Gallagher, 2020; Parette et al., 2010). Today's technologies are more accessible, easier to use, and more affordable. As such, there is an increasing use of electronic toys, computers, tablets with touch screens, mobile devices, and e-books in early childhood programs (Flewitt et al., 2015). In fact, most recently, with the global coronavirus pandemic in 2020, school teams needed to make a swift move to integrate technology in early childhood education. Fortunately, there is emerging research to support that when used in developmentally appropriate ways, technology can enhance the early literacy learning of young children (Flewitt et al., 2015; Neumann & Neumann, 2017; Shamir et al., 2019). A review of research by Neumann and Neumann (2017) found that tablets and high-quality literacy applications (apps), when used to scaffold learning, had positive effects on children's early literacy skills, such as emergent writing and letter learning. Although these advances in technology benefit all children, for some children with disabilities, these technologies are necessary to be successful and reach their potential (Dean, 2020).

Ms. Miriam teaches in a community-based early care and education center, has 5 years of teaching experience, and has no formal training in special education. Although Ms. Miriam is excited to welcome Ana, a 4-year-old girl with Down syndrome, into her class, she is also concerned about how she will meet Ana's learning needs and fully include her in early literacy instruction. According to Ana's individualized education program (IEP), she loves to look at books and enjoys interacting with peers and adults. She is also a visual learner and can select between two or more choices when presented with pictures or actual objects. Ana is minimally verbal. The IEP indicates she needs verbal instructions repeated multiple times and frequently leaves her designated area during shared reading. When Ana selects a book to read during shared reading, Ana turns the pages of the book very quickly while Ms. Miriam sits next to her and reads the story. Ms. Miriam wonders how she can purposely engage Ana in shared reading activities to help develop her early literacy skills.

When used in developmentally appropriate ways, technology can enhance the early literacy learning of young children.

Early literacy instruction plays a key role in developing the skills necessary to become literate and successful both inside and outside of school. Literacy development begins with talking and listening and grows with connecting oral language with reading and writing (Oncu & Unluer, 2015). Children's early experiences with language greatly influence vocabulary development, reading skills, and school performance (Walker et al., 2020). To develop the early literacy skills necessary for academic success and competency in a literate society, children must be provided with opportunities to meaningfully engage in literacy-rich experiences throughout the day (Temple, 2019).

Research has shown children vary greatly in how they access, use, and engage in learning opportunities (Walker et al., 2020). Children with disabilities tend to acquire early literacy skills at a slower rate than their same-age peers (Burne et al., 2011). Although the Individuals With Disabilities Education Act (IDEA; 2004) mandates provisions for special education supports and services, the majority of young children with disabilities still lag far behind in the development of early literacy skills compared with their typically developing peers (Pears et al., 2016). The use of assistive technology (AT) may be one approach for providing the necessary adaptations to help address these discrepancies and create opportunities for children with disabilities to actively engage in literacy-rich activities (Parette et al., 2010).

There is clear evidence that AT improves early language and literacy outcomes for young children with a range of disabilities, including autism spectrum disorder, cerebral palsy, Down syndrome, and multiple disabilities (Dunst et al., 2012; Erickson, 2017; Ganz & Simpson, 2019; Romski et al., 2010). A systematic review by Dunst et al. (2013) concluded that the use of computers, powered mobility, augmentative communication, and switch interfaces with young children with developmental disabilities were associated with improvements in literacy and communication as well as overall development. Additionally, Light et al. (2019) summarized preliminary literature supporting the use of augmentative and alternative communication to promote both vocabulary development and the acquisition of sight words for individuals with complex communication needs. This research suggests that a range of AT can positively impact a diverse group of children and improve literacy outcomes.

The purpose of this article is to describe how teachers can integrate practical AT tools and strategies into early literacy instruction using a framework called SETT (Student Environment Task Tool; Zabala, 1995). The SETT framework is a widely known and easy-to-use planning tool to identify a child's need for and to select appropriate AT (Floyd et al., 2020). The use of AT and the SETT framework aligns with practices ENV4, ENV5, INS4, and INS5 recommended by the Division for Early Childhood (DEC; 2014), which are evidenced-based strategies to support the needs of young children with disabilities. DEC Recommended Practices (DEC, 2014) emphasize practitioners and families working together to identify the need for AT, to plan for AT, and to provide appropriate AT adaptations and strategies to promote access to and participation in early learning experiences.

Overview of the SETT Framework

After participating in a professional development workshop, Ms. Miriam has gained knowledge about a variety of AT tools to increase Ana's engagement during shared

Table 1 **SETT (Student, Environment, Tasks, Tools) Framework Questions to Guide IEP Teams**

S	*E*	*T*	*T*
Student	*Environment*	*Tasks*	*Tools*
• What are the child's strengths? • What are the child's abilities? • What are the child's early literacy needs? • What are the child's interests and preferences? • What are the child's expectations and concerns?	• In what environments is the child expected to complete early literacy tasks? • What physical arrangements of the environment need to be considered? • What support is available in the environment for the child and staff? • What materials and equipment are available in the environment? • What environmental factors need to be considered (e.g., lighting, visual stimulation, noise level)?	• What specific task do we want the child to complete? • Is this task related to the goals on the IEP? • Is this a task the child is expected to complete at home and at school? • What does successful participation in the task look like? • Is the child able to complete the task with special accommodations or strategies?	• What AT tools are needed to address the child's need? • Will the AT help the child complete the identified task? • Where will the team obtain the AT (e.g., currently available in the classroom, borrow AT from state lending library)? • What training and support does the team or child need? • Who will ensure the AT tools are available when and where needed?

Note. IEP = individualized education program; AT = assistive technology.

reading activities. For example, she has learned how to use pictures of animals and animal puppets to pair with a book about animals to help Ana associate the words with actual objects. Ms. Miriam has discovered an interactive e-book to practice rhyming words with Ana. She has also received training on how to borrow voice output communication devices from her state's AT program and consulted with Ana's speech and language pathologist about using a communication device to help Ana answer questions and comment about her favorite books. Before beginning to use these AT tools, Ms. Miriam schedules a meeting with Ana's parents and IEP team to decide how to meaningfully integrate AT into her early literacy instruction. The team decides to use the SETT framework to guide their decision making regarding embedding AT to increase Ana's engagement during shared reading tasks.

One team-based approach for the selection and application of AT is called the SETT framework (Zabala, 1995, 2020). SETT is one of the most commonly used tools to help school teams gather information for AT decision making (Evmenova, 2020; Satterfield, 2016; Zabala, 2020). As shown in ***Table 1***, the SETT framework is designed to guide IEP teams through a series of key questions to make informed decisions and select the right AT for the child (Satterfield, 2016). Like other AT decision-making models, the goal of the SETT framework is to connect the child with the appropriate AT by exploring the child's needs, environment, and tasks (Satterfield, 2016). The SETT framework places the emphasis on the child, not the AT, with additional considerations on the environment and task (Da Fonte et al., 2016).

Step 1: Student (The "Who")

The first step in the SETT framework is the *S*, which focuses on the student or child. In this stage of SETT, individuals work together to build shared knowledge about the child's current needs and performance in early literacy activities. The team should include the individuals who make decisions about the child's success in the classroom as well as those who can support the child at home (Floyd et al., 2020; Zabala, 2020). Every person brings a different set of skills and perspectives to the team, and sharing of these perspectives in a fair and nonjudgmental way leads to a consensus among group members about important next steps (Zabala, 2020). The team collects data on the child's preferences, abilities, and needs. Data are collected on the child's current level of early literacy skill development and any barriers that may be interfering with the child's participation in early literacy instruction.

During the initial meeting with Ana's parents and IEP team, they develop a plan to improve Ana's engagement during shared reading activities by reviewing her current abilities, interests, and concerns as well as their collective expectations. This meeting includes Ms. Miriam, the teacher aide, Ana's parents, the assistant principal, and Ana's speech pathologist. The team identifies that Ana responds best to hands-on activities where she can look at pictures, interact with props, or explore objects during literacy instruction. She enjoys turning pages of books, has a short attention span, and often needs directions repeated multiple times. Ana's team reviews her current IEP and matches expectations with her current learning goals of following directions the first time and participating in a directed or self-selected story activity for 5 minutes by looking and pointing at pictures in a book.

Step 2: Environment (The "Where")

The *E* in the SETT Framework stands for "environment" and targets the learning environments where AT will be used.

> **AT is a means to actively engage a child in tasks that offer the opportunity for the child to build early literacy skills.**

The home or classroom environment should be designed to provide numerous opportunities for the child to build early literacy skills throughout the day (Zabala, 2020). In the early childhood classroom, the environment can be broken down into parts of the everyday routine where early literacy instruction takes place. The child's team should examine the environmental layout (e.g., the physical, social, and temporal environments) to see if there are barriers or distractions interfering with the child's participation and engagement (see ***Table 1***). The team can then use this information to make modifications prior to instruction that can purposefully increase the child's access to the content (IRIS Center, 2021; Zabala, 2020). Once environmental factors are determined, the next step is to break down the routines into manageable tasks (Da Fonte et al., 2016).

To determine how AT can fit into Ana's environment, the team discusses when and where Ana struggles with actively engaging in early literacy activities. To collect data, members from the team observe Ana three times over the course of the week. During the shared reading observation, the teacher aide notices that Ana often turns around to play with the materials on the shelves. The team decides to change the furniture arrangements in the room to make it easier for Ana to focus during instruction. They use double-sided tape to place curtains over the bookshelves to limit distractions for Ana and to help her stay more engaged during the shared reading activity.

Step 3: Task (The "What")

The next stage in the SETT framework is the first *T*, which stands for "task." The IEP team needs to determine which specific tasks the child is expected to be able to do. If there are no tasks that the child is expected to do, then AT tools are not likely to have a positive impact, because it will not be clear which actions those AT tools are expected to support (Zabala, 2020). AT is a means to actively engage a child in tasks that offer the opportunity for the child to build early literacy skills. Tasks have a beginning and an end and may include multiple steps (Zabala, 2020). Once the steps have been identified, the team looks at possible elements of the task that would be difficult or impossible for the child to do independently. The IEP team gathers information about the task and the skills needed to complete the task (Zabala, 2020). As illustrated in ***Table 1***, questions to consider include "What is the task we want the child to be able to do?" "Is the child able to complete the task with special accommodations or strategies?" and "Would AT help the child perform the task more easily?" (Floyd et al., 2020). These data inform which tools are needed to address those difficulties and build engagement in early literacy tasks and can be used for planning and evaluating the effectiveness of the AT tool.

Concepts about print. *Concepts about print* refers to the child's ability to understand the ways in which print functions in the process of reading and to recognize words as components of oral and written communication (Brown, 2014). To target concepts about print, teachers can expose children to a variety of books and embed AT to help children access the stories in their natural learning environment. For instance, a teacher can adapt a book by adding popsicle sticks to the pages so that a child with cerebral palsy can independently turn the pages during story time and gain an understanding of book orientation and directionality. As demonstrated in ***Table 2***, a teacher can pair the book *The Little Engine That Could* (Piper, 1991) with actual toy trains during circle time to help students recognize that print conveys meaning. A teacher can also match words in a book with picture communication symbols from a software program, like Boardmaker (Mayer-Johnson, 2002), to connect letters and words to pictures.

Alphabet knowledge. *Alphabet or letter knowledge* refers to the ability to name printed letters and to identify sounds associated with each letter (Goldstein et al., 2017). Teachers can incorporate alphabet books and props in shared reading to target alphabet knowledge. As shown in ***Table 2***, for a child with vision difficulties, a teacher can use light-colored magnetic letters on a dark surface, such as a metal baking sheet, to create color contrast as a visual support while reading an alphabet book, such as *Chicka Chicka Boom Boom* (Martin et al., 1989). A child with a fine motor delay can create an alphabet book by coloring or drawing favorite animals for each letter using a slant board and a large grip crayon. Research-based, multisensory apps, like Lively Letters (Reading with TLC, 2021), can foster letter and sound recognition through hands-on activities to increase engagement.

Phonemic awareness. As children develop print awareness, they begin to know what print looks like, how it works, and that print carries meaning (Goldstein et al., 2017). To help a child develop phonemic awareness, a teacher and child can read rhyming books, sing songs, and play rhyming games. Singing and rhyming help children pick up smaller sounds in words. As illustrated in ***Table 2***, a teacher can use a four-message voice output device to identify words, such as "mat" and "bat," that rhyme with "cat." Additionally, interactive e-books can feature read-aloud functions to help build students' independence during story time and can offer repeated exposure to increase familiarity with the content. Tar Heel Reader (Center for Literacy and Disability Studies, 2020) offers a collection of free, easy-to-read, and readily available e-books on a wide range of topics at www.tartheelreader.org.

Vocabulary development. Vocabulary development involves repeated exposure and interactions with words and promotes children's understanding of a word's meaning (Walker et al., 2020). Talking

Table 2 **Examples of AT Tools to Support Early Literacy Activities**

Early literacy activity	*AT activity support description*	*Example*
Concepts about print: Pair words in the book with actual objects.	Teacher pairs book about trains with a toy train.	
Letter knowledge: Incorporates alphabet books and props in shared reading.	Teacher uses magnetic letters as visual supports while reading *Chicka Chicka Boom Boom* alphabet book with a small group of children.	
Phonemic awareness: Say a word and have the child fill in the rhyming word.	Teacher uses a multimessage communication device to make words that rhyme with "cat."	
Vocabulary instruction: Read books with repeatable lines and phrases.	Two children read *Brown Bear, Brown Bear, What Do You See?* and take turns using a two-message communication device to read the repeatable line of the story.	

Note. AT = assistive technology.

> **Once teachers identify the literacy tasks, they can use this information to determine which types of AT could be integrated into their classrooms.**

and reading are important ways for children to develop oral language and vocabulary. To target vocabulary development, a teacher can read books with repeatable lines and phrases. For example, a teacher records the story *Brown Bear, Brown Bear, What Do You See?* (Martin & Carle, 2012) on a talking photo album while a child with autism presses the button on the talking photo album to read the repeatable line of the story (see ***Table 2***). Another idea is for the teacher to create an activity board with pictures of the animals in *Brown Bear* to support a child's comprehension and reinforce vocabulary from the story. Additionally, teachers can use developmentally appropriate educational apps, such as Endless Alphabet (Originator Inc., 2013), on an iPad to engage children in building their vocabulary in an interactive way. Teachers can use these examples of literacy tasks to connect them to their current literacy practices. Once teachers identify the literacy tasks, they can use this information to determine which types of AT could be integrated into their classrooms.

Ms. Miriam works with Ana's team to break down the task by determining what they want Ana to do during the shared reading activity. During shared reading, Ana is typically in a group of four other students while Ms. Miriam reads a book with repeated lines. The students are expected to stay seated, imitate the repeated lines out loud, and answer simple questions about the pictures in the book. These tasks are aligned with Ana's current IEP goals; however, she is unable to independently pair words with pictures or repeat the repeatable

> **Training on how to pair AT strategies with specific literacy skills can provide concrete ways to increase teacher understanding, confidence, and skill to successfully embed AT.**

line of the story back to the teacher given her current expressive language skills. Ana's team decides to utilize AT that can help Ana pair words and pictures and repeat the repeatable line of the story.

Step 4: Tool (The "How")

The last stage of the SETT framework is to consider the tool. This stage focuses on determining the AT best suited for addressing the child's needs. According to IDEA (2004), AT encompasses any tool or service that is used to increase, maintain, or improve the functional capabilities of children with disabilities and must be considered for every child during the development of a child's IEP. A child who is eligible to receive special education services under IDEA is also eligible to receive AT at no cost to the family if it is determined that the child needs such AT to access learning as part of the child's IEP (Plunkett et al., 2010). For young children with disabilities, incorporating AT tools and strategies in teacher instruction can offer needed adaptations to the environment to enhance a child's engagement in early literacy learning by providing a means to better access materials (Dunst et al., 2012) and increase participation in daily activities (Simpson & Oh, 2013).

As mentioned in ***Table 1***, the team collects information on what AT tools and devices are needed as well as what services and strategies are required to help the child become more engaged in the targeted tasks (Zabala, 2020). AT is any piece of equipment that improves the functional abilities of an individual with a disability and can vary from no- and low-tech to mid- and high-tech (Floyd et al., 2020). No- and low-tech tools are simple, nonelectronic tools that are easy to use and less expensive than mid- and high-tech tools. Additionally, no- and low-tech AT are frequently preferred because they provide the support a child needs without the burden of a more costly or cumbersome device (Simpson & Oh, 2013). Mid- and high-tech tools are more complex, electronic tools that can be more expensive and require some training to use. Nevertheless, mid- and high-tech tools offer more features and thus provide young children with disabilities interactive ways to explore their literacy-rich environment in multiple formats (Sadao & Robinson, 2010). See ***Table 3*** for examples of no- and low-tech to mid- and high-tech AT supports.

Before implementing AT, teachers, family members, and relevant school staff need to determine who will introduce the AT tool. When targeting specific activities in the classroom, the team should allow for a teaching period when the adult first models how to use the AT tool for the child. Applying an "I do, we do, you do" modeling method is often appropriate as the child moves from introduction to full understanding and use of the AT tool (Fisher & Frey, 2013). Throughout the teaching-and-implementation phase, consistency is important to ensure that the child understands the purpose of the AT and how to use the tool.

As the AT becomes more familiar and embedded into the child's daily routine, continued monitoring is vital to ensure that the AT tools are consistently and correctly implemented. Collecting data before and during AT implementation ensures an objective understanding of the effectiveness of the tool. If no progress is made after consistent AT implementation, modifications may be necessary. Modifications should consider the child's abilities, the complexity of the AT support, the need for further teacher training, and how these supports are adapted to the child's routine. Continuously assessing the child's progress and utilization of the AT provides a guide for accurate decision making, helps educators plan for effective use of AT, and fosters children's engagement by increasing understanding and access to instruction.

Only after Ana's team has collected data on her abilities and needs, her environment, and the task do they start to consider which AT strategies are needed to help Ana actively engage more in early literacy tasks. Utilizing Ana's strength as a visual learner, they decide to use visual props when reading books. They also program a BIGmack, a single-message communication device, to help Ana repeat lines from the story. Her parents are also able to borrow a BIGmack and adapted books with props from their statewide AT program so they can use these tools at home. Ms. Miriam documents Ana's progress to keep track of what is working and not working so the AT plan can be adjusted as needed. The SETT framework has created an efficient way for Ms. Miriam to identify individualized supports needed to foster Ana's literacy skills.

Conclusion

In spite of documented benefits and legislative mandates for children from birth through age 22, AT is highly underused, especially among young children (Dunst & Trivette, 2011). One of the main reasons for this underuse is that although teachers are legally required to provide AT for children with disabilities, many teachers do not have the knowledge, confidence, or skills needed to provide AT to support early literacy instruction (Dean, 2020; Hilaire & Gallagher, 2020). The challenge for teachers is how to use technology, in particular, AT, in thoughtful and meaningful ways to support young children with disabilities (Temple, 2019). Professional development resources and opportunities are needed to help teachers garner the skills to identify and match AT to each child's strengths, needs, and preferences and then to plan for and integrate the AT in early literacy instruction (DEC, 2014; National Association for the Education of Young Children & Fred Rogers Center, 2012). Training on how to pair AT strategies with specific literacy skills can provide concrete ways to increase teacher understanding, confidence, and skill to successfully embed AT in appropriate ways in the classroom (Natale et al., 2020).

The Step Up AT to Promote Early Literacy Project (www.stepupat.com) is a free online resource designed to help teachers learn to use AT to support early literacy skills funded by the U.S. Department of Education Office of Special

Table 3 **Examples of No- and Low-Tech to Mid- and High-Tech Assistive Technology Supports**

Type of technology	*Assistive technology*
No- and low-tech	Book stands and slant boards
	Large grip crayons
	Page turners, such as popsicle sticks, index tabs, or clothes pins
	Manual communication board (symbols, pictures, or words)
	Pairing words with objects, props, or pictures
Mid-tech	Switches (BigRed, Blue2 Switch)
	Talking photo album
	Single Message Communication Device (BIGmack)
	Multiple Message Communicator (iTalk 2, Go Talk 4)
High-tech and digital	Tablet with visual support application software
	Choiceworks app (iOS)
	My Story School eBook Maker (iOS)
	Visual Timer app (iOS, Android)
	Tablet with communication support application software
	Avaz Pro app (iOS, Android)
	GoTalk Now app (iOS)
	TouchChat app (iOS)
	Software for visual and communication supports
	Boardmaker software
	Lesson Pix software

Education (Natale et al., 2020). Teachers who participate in the program benefit from online learning modules and virtual coaching sessions. The curriculum emphasizes various AT tools and strategies to promote children's engagement in early literacy and how to plan for and integrate AT using the SETT framework (Natale et al., 2020).

In addition, state chapters of the Association of Assistive Technology Act Programs (www.ataporg.org) can be a beneficial first step for teachers to gain access to AT devices and training. These programs offer lending libraries where teachers, parents, and other professionals can borrow AT devices to "try before you buy." Furthermore, the Early Childhood Technical Assistance Center Practice Improvement Tools website promotes the use of the DEC's (2004) Recommended Practices and a number of these resources focus directly on AT use.

Last, the Special Education Innovation Network, a national group of special education researchers, nonprofits, and AT and software developers, developed a series of research-based guides with education technology resources to support teachers and children with disabilities. The resource guides include several programs focused on early literacy and are available online through the Institute for Education Sciences (https://ies.ed.gov/blogs/research).

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