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For over a century, early childhood experts have discussed the importance of play for young children's growth and development. Play is critical for the development of young children as it increases learning (Barton, 2015), supports young children in gaining social and communication skills (Dennis & Stockall, 2015), and leads to social awareness and empathy skills (Brown, 2009). However, for young children with disabilities, accessing play and social interactions can prove to be challenging (Fallon & MacCobb, 2013). In order to support preschoolers with disabilities in learning through play, the authors recommend the use of assistive technologies (AT) for (a) communication, (b) mobility, and (c) independence. This article presents information about specific assistive technology devices and supports in each of these three areas.

Keywords: assistive technology, early childhood, inclusion, play, preschool

Over half of all preschoolers with disabilities are currently receiving instruction in the inclusive classroom (Lawrence, Smith, & Banerjee, 2016; Odom, 2000; Odom, Buysse, & Soukakou, 2011). The literature has identified the benefits of including young children with disabilities in the preschool classroom. These benefits include reductions in challenging behaviors (Odom, 2000), increased academic learning (Lawrence et al., 2016; Odom, 2000; Weiland, 2016), emotional competence (Weiland, 2016), communication skills (Lawrence et al., 2016; Odom et al., 2011), social gains for typically developing peers (Lawrence et al., 2016; Odom, 2000; Yu, Ostrosky, & Fowler, 2012), and a reduction in programming costs (Odom et al., 2001). In order to ensure that young children with disabilities receive the most benefit from inclusion, it is critical to provide learning supports to meet their needs. Because play

skills are a significant component of preschool learning, early childhood special educators must be prepared to provide accommodations that assist young children in play. This article provides a brief overview of assistive technologies that can be used to support play for children with disabilities in the inclusive classroom.

Importance of Play

For over a century, early childhood experts have discussed the importance of play for young children's growth and development. Play is a powerful and critical vehicle for building communication skills in young children, and play provides children opportunities to communicate with peers and adults (Golinkoff & Hirsh-Pasek, 2016). Through play, children gain social, emotional, physical, and cognitive skills (Ginsburg, the Committee on Communications, & the Committee on Psychosocial Aspects of Child and Family Health, 2007). John Dewey (1916) explained that children learn about the world through natural play. According to Friedrich Froebeli, often referred to as the father of kindergarten, children learn how to work together and gain self-control through play (Platz & Arellano, 2011). Maria Montessori built on this research by advocating for the need for young children to be active participants in their own learning through real-world play and natural discovery (Edwards, 2002; Platz & Arellano, 2011). Play is critical for the development of young children as it increases learning (Barton, 2015), supports young children in gaining social and communication skills (Dennis & Stockall, 2015), and leads to social awareness and empathy skills (Brown, 2009).

Due to its importance in children's development, the United Nations Commission on Human Rights has declared play as a basic human right for all children (Ginsburg et al., 2007). It is clear that play is critical for all children. However, for young children with disabilities, accessing play and social interactions can prove to be challenging (Fallon & MacCobb, 2013) due to physical, cognitive, and/or communication barriers. In order to support preschoolers with disabilities in play, the authors recommend the use of assistive technologies for (a) communication, (b) mobility, and (c) independence. This article presents information about specific AT devices and supports in each of these three areas.

Overview of Assistive Technology

Under the federal guidelines outlined in the Individuals with Disabilities Education Act (IDEA; 2004), assistive technology (AT) is defined as "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability." The use of assistive technology aids children with disabilities in meeting the same outcomes as their typically developing peers (Puckett, 2005). In the inclusive early childhood classroom, assistive technologies can be used to support a variety of skills, including play skills and interactions with peers. Inclusive preschool teachers are encouraged to create a universally designed learning environment in which all children can participate and be engaged (Horn, Palmer, Butera, & Lieber, 2016). The research literature supports the use of several types of AT, ranging from low-to-high tech, to increase movement in children with motor delays and access to the early learning curriculum. While the research that supports use and consideration of AT is mandated under IDEA, there currently is no

federal requirement for the AT consideration process and many states have developed their own process or are using the Wisconsin Assistive Technology Initiative Assistive Technology Consideration Guide (IRIS, 2019).

Guidelines and Recommend Practices

The use of assistive technology in the inclusive preschool classroom is supported by best practices in instruction as outlined by a variety of professional organizations. The National Association for the Education of Young Children (NAEYC) created the Developmentally Appropriate Practice (DAP) guidelines in order to provide a framework for supporting the learning needs of children from birth to age 8 (NAEYC, 2009). Similarly, the Division for Early Childhood (DEC) of the Council for Exceptional Children published the Recommended Practices to identify evidence-based practices for supporting young children with disabilities (DEC, 2014). Finally, the Council for Exceptional Children (CEC) and the Collaboration for Effective Educator Development, Accountability, and Reform (CEEDAR) Center released a document outlining the High Leverage Practices (HLPs), which are teaching practices that lead to positive outcomes for children with disabilities (McLeskey et al., 2017). The specific alignment with each of these sets of guidelines is identified with a figure in each section of this article.

Assistive Technology for Communication

Mr. Andy is a preschool teacher concerned about a new student in his classroom of diverse young learners. Hannah joined his class two weeks ago and has mixed receptive-expressive language disorder, which makes communicating with her classmates difficult. Mr. Andy noticed that Hannah had limited engagement with her peers during center time and playtime due to difficulty understanding spoken language and speaking to peers. Mr. Andy noticed that Hannah would stand within a few feet of her classmates, watching them play, but did not initiate any interactions with them. When classmates tried to speak with her, Hannah looked at them, but did not respond. Mr. Andy noticed that the other children tried less frequently to play with Hannah than they did when she first joined the class.

Like Hannah, many young children with disabilities struggle to communicate effectively and the communication barrier prevents learning and play. To engage in social play, children need to initiate and respond to social stimuli and negotiate conflict (Beckman & Leiber, 1994). Thus, difficulties with communication may negatively impact play and social relationships (Craig-Unkefer & Kaiser, 2002). For those who struggle with communication, AT tools can facilitate communication and are especially important for young children with developmental delays, communication disorders, and emergent bilinguals.

Research demonstrates the benefits of using AT to increase receptive and expressive language development in young children (Parette & Stoner, 2007). Receptive language is the ability to comprehend or understand what others say. Expressive language is the ability to use vocabulary to express one's thoughts (Gillis, Luthin, Parette, & Blum, 2012). In typical development, receptive language develops ahead of expressive language; based on this knowledge, we recommend that early childhood educators focus on improving receptive language first or provide supports in both areas simultaneously. Both receptive and expressive language development are used

and developed during play. Through the use of assistive technology tools in play and learning, young children with communication delays may increase both their language and social skills (Thomas-Stonell, 2016).

After seeing Hannah and other students pointing to pictures on the class schedule and on the calendar, Mr. Andy decided to add photographs of his students and other images to each center. The students immediately noticed the picture cards and all students began incorporating them into their play. Mr. Andy also created a picture board and will introduce it during circle time tomorrow morning.

AT for communication also includes augmentative and alternative communication (AAC) devices. AT and AAC devices can be no tech (e.g., gestures, sign language), low tech (e.g., picture boards, images, pencils and paper, drawings) or high tech (e.g., tablets, smartphones, speech generating devices, apps). There are many types of AT that help young children communicate and interact with peers and adults that would be challenging or even impossible without assistance. For example, when early childhood teachers use pictures or symbols to represent activities and tasks and insert the images in schedules, calendars, and lists, children are presented with readily accessible language that enhances early communication development (Judge, Floyd, & Jeffs, 2008). In order to determine the specific AAC that will best meet the needs of a child, his/her individual needs and goals must be considered and the appropriate AT may change as the needs of the child change (Vanderbilt Kennedy Center, 2012).

Mr. Andy was pleased to see Hannah and other students using the visual supports, including photographs and picture cards to increase communication during centers and throughout the day for play. He noticed that Hannah is more engaged in playing with her classmates during centers time.

As illustrated in the vignette of Mr. Andy and Hannah, low-tech AT in the form of visual supports can increase student communication. The use of AT for supporting young children's communication skills aligns with NAEYC's DAP, DEC Recommended Practices, and the CEC/CEEDAR Center HLPs, as outlined in Figure 1.

Assistive Technology for Communication

Aligned NAEYC DAP Guidelines

- 2E: Teachers plan the environment, schedule, and daily activities to promote each child's learning and development.
- 2G: Teachers know how and when to scaffold children's learning - that is, providing just enough assistance to enable each child to perform at a skill level just beyond what the child can do on his or her own, then gradually reducing the support as the child begins to master the skill, and setting the stage for the next challenge.
- 2J: Teachers make experiences in their classrooms accessible and responsive to all children and their needs - including children who are English language learners, have special needs or disabilities, live in poverty, or other challenging circumstances, or are

from different cultures.

Aligned DEC Recommended Practices

- E1: Practitioners provide services and supports in natural and inclusive environments during daily routines and activities to promote the child's access to and participation in learning experiences.
- E5: Practitioners work with families and other adults to acquire or create appropriate assistive technology to promote each child's access to and participation in learning experiences.
- INS4: Practitioners plan for and provide the level of support, accommodations, and adaptations needed for the child to access, participate, and learn within and across activities and routines.
- INT2: Practitioners promote the child's social development by encouraging the child to initiate or sustain positive interactions with other children and adults during routines and activities through modeling, teaching, feedback, or other types of guided support.

Aligned CEC & CEEDAR Center HLPs

- HLP 19: Use assistive and instructional technologies.
  Teachers select and implement assistive and instructional technologies to support the needs of students with disabilities. They select and use augmentative and alternative communication devices and assistive and instructional technology products to promote student learning and independence.

Figure 1. *Alignment with professional organization guidelines/recommended practices in using AT for communication*

Assistive Technology for Mobility/Gross Motor Skills

Ms. Allison is an Early Childhood Special Education (ECSE) teacher in an inclusive preschool classroom with 12 children (five with disabilities or delays). Hanson is a three-year-old child with Down syndrome and motor challenges that recently started attending her room. Due to his motor delays, he requires the help of an adult to carry him from place to place. Although Ms. Allison has two dedicated paraprofessionals, they are needed to prepare activities and support the other children during the day. Hanson has many strengths; he uses single words to communicate and follows simple directions. He enjoys playing with peers; however, due to his mobility issues (i.e., wide gait, crawls using both arms and legs), he does not engage in active motor play as often as his peers. Ms. Allison is not sure how to help support him. She knows that he needs to move more frequently, with less adult support, to engage in meaningful interactions with peers and increase participation in daily activities. Ms. Allison is curious if AT supports may help Hanson to better access learning and play.

Like the earlier vignette with Mr. Andy and Hannah, the example with Hanson shows the impact a disability may have on a

young child's ability to fully participate in a classroom learning. Mobility is an essential skill needed for children in preschool settings. Gross motor skills (i.e., running, walking, and climbing) in early childhood allow for exploration and movement in the surrounding environment. In the classroom, children engage in movement during physical activities that require control, balance, and coordination of large muscles (Cools, DeMartelaer, Samaey, & Andries, 2009). These activities often include transition to and from learning centers, small and large group exercises, and outside play. It is recommended that preschoolers participate in a minimum of 60 minutes of both structured and unstructured physical activity per day (National Association for Sport and Physical Education, 2010). Physically active children are more likely to engage in self-initiated interactions with classroom materials and peers (Malina, 2014; Ross et al., 2016). Research has shown that frequent physical activity results in thriving executive functioning, cognition, social skills, and communication skills in children (Lobo et al., 2013; Logan et al., 2015; Mora-Gonzalez et al., 2019). In addition, active children are at a lower risk for health concerns and weight gain later in life (Strong et al., 2005). Further, the benefits of physical activity for children have been shown to lead to academic success later in life (Coe et al., 2006).

As she begins to explore how to best meet Hanson's needs, Ms. Allison realizes that Hanson would benefit from mobility equipment. With the assistance of her school district AT specialist, Ms. Allison arranges a walker trial for Hanson. She takes data on its' effectiveness for increasing Hanson's interactions with his peers and his access to classroom learning, including play. After two weeks of the trial, the data shows a significant increase in interactions between Hanson and his peers, as well as a significant decrease in the amount of time that Hanson is not engaged in learning. Based on this data, Ms. Allison requests an IEP meeting to add mobility supports to Hanson's IEP.

The example of Hanson and Ms. Allison represents the challenges of children with motor delays and their teachers leading to less self-initiated movement. These children are at a greater risk for delays than their typically developing peers (Emck, Bosscher, Beek, & Doreleijers, 2009), engage in less self-initiated movement and participate less in activities with their typically developing peers (Carlon, Shields, Dodd, & Taylor, 2013; Logan et al., 2015). Some children with motor challenges require physical support from an adult to transition and join activities; ensuring this can be difficult in classrooms with minimal staff and other children with needs. Children with mobility issues often spend more time alone and/or observing peers instead of actively participating in play. In the early years, a child's ability to engage in play exploration is a predictor of future executive functioning, collaboration, problem-solving skills (Logan et al., 2016; Tefft, Guerette & Furumasu, 1999).

Low-tech devices tend to be less expensive, motor-less and are often easier to access than high technology options. High-tech include those devices that are electronic and/or require a motor. The use of low and high-tech AT to support mobility aligns with NAEYC's DAP, the DEC Recommended Practices, and the HLPs, as outlined in Figure 2.

Assistive Technology for Mobility

Aligned NAEYC DAP Guidelines

- 1D: Practitioners design and maintain the physical environment to protect the health and safety of the learning community members, specifically in support of young children's physiological needs for activity, sensory stimulation, fresh air, rest, and nourishment. Outdoor experiences, including opportunities to interact with the natural world, are provided for children of all ages.
- 2E: Teachers plan the environment, schedule, and daily activities to promote each child's learning and development.
- 2G: Teachers know how and when to scaffold children's learning - that is, providing just enough assistance to enable each child to perform at a skill level just beyond what the child can do on his or her own, then gradually reducing the support as the child begins to master the skill, and setting the stage for the next challenge.
- 2J: Teachers make experiences in their classrooms accessible and responsive to all children and their needs - including children who are English language learners, have special needs or disabilities, live in poverty, or other challenging circumstances, or are from different cultures.

Aligned DEC Recommended Practices

- E1: Practitioners provide services and supports in natural and inclusive environments during daily routines and activities to promote the child's access to and participation in learning experiences.
- E5: Practitioners work with families and other adults to acquire or create appropriate assistive technology to promote each child's access to and participation in learning experiences.
- E6: Practitioners create environments that provide opportunities for movement and regular physical activity to maintain or improve fitness, wellness, and development across domains.
- INS4: Practitioners plan for and provide the level of support, accommodations, and adaptations needed for the child to access, participate, and learn within and across activities and routines.

Aligned CEC & CEEDAR Center HLPs

- HLP 19: Use assistive and instructional technologies.
  Teachers select and implement assistive and instructional technologies to support the needs of students with disabilities. They select and use augmentative and alternative communication devices and assistive and instructional technology products to promote student learning and independence.

Figure 2. *Alignment with professional organization guidelines/recommended practices in using AT for mobility*

Low-tech AT for Gross Motor Skills. Low-tech options used to improve participation in preschool include: (a) adaptive equipment (Horn & Warren, 1987), (b) prosthetics and/or orthotics (Egermann, Kasten, & Thomsen, 2009), (c) ambulatory (walking) support (Paleg & Livingstone, 2015), and (d) vehicles (Huang & Galloway, 2012; Logan et al., 2017). Adaptive play equipment can be used outside and in classroom areas to improve access to activities that are inaccessible to children with motor disabilities. Swings, gliders, and merry-go-rounds can be adapted on playgrounds so children with wheelchairs or physical challenges can use them (Rasche, Dedrick, & Hanus, 1991). Positioning equipment can be adapted to provide children with postural support and proper alignment during activities (Breath, DeMauro & Snyder, 1997). Prosthetics (i.e., artificial limbs) can be used to replace missing appendages (Egermann, Kasten, & Thomsen, 2009) and orthotics (e.g., braces, shoe inserts) may help children to achieve proper stability and alignment leading to increased movement. Children can learn to navigate the learning environment using walkers (Eisenberg et al., 2009) or gait trainers (Barners & Whinnery, 2002). Some devices include sensors on shoes (Lancioni et al., 2007b) or switches (Lancioni et al., 2013) to provide additional guidance and support to the child.

For Hanson, it is possible that his teacher may consider the use of walker in the classroom to improve mobility. The walker may allow more independent mobility, thereby, increasing his opportunities to self-initiate and decreasing his reliance on the adults in the classroom. Further, vehicles such as scooter boards (Lane & Mistrett, 1996), tricycles (Sheldon, 1996) and manual wheelchairs (Nabors & Keyes, 1997) have been used to help the child engage with peers and transition to and from activities. Assistive technologies provide the opportunity for children to build strength, improve gross motor movements, and enhance functional motor skills. In addition, vehicles provide the opportunity for improved participation, proximity to peers and social engagement.

High-tech AT for Gross Motor Skills. High tech devices have similar goals to low-tech options. The primary difference is the reliance on a battery or electricity to run the device. Power wheelchairs are an example of high tech AT and are a feasible option to support the mobility of preschool children in inclusive settings (Guerette, Furumasu, & Tefft, 2013).

A more inclusive option to facilitate inclusion for preschool children was the creation of power-cars. Logan et al., (2016) modified existing child-sized power wheel vehicles to allow for an option less expensive than power wheelchairs. These cars emerged with the goal of engaging children with disabilities more frequently with their typical peers. The Go Baby Go program (Huang et al., 2012) created cars that children use through switch activation. These cars have been modified to provide a *Throw Baby Throw* option that utilizes a pinching machine to throw foam balls and a sit-to-stand car that encourages the child to stand in order to move the vehicle (Logan et al., 2017). The different functions of these vehicles allow children the opportunity to participate and engage in new ways across the inclusive learning environments.

Assistive Technology for Supporting Independence during Play

Miss Rosa is a preschool teacher supporting a range of diverse learners in her preschool classroom. There are some children who recently immigrated from

different countries and are learning English; several children have complex communication needs, and other children need help interacting with their peers. Free play and recess times are especially difficult routines because the children struggle to communicate with one another and spend a large portion of the time standing and waiting for Miss Rosa to tell them what they should do. Miss Rosa and her team have decided to use assistive technology to support all children to gain independence during play.

In Miss Rosa's vignette, we see the impact that independence has on children's play and social interactions. Play is the foundation of early childhood (Golinkoff & Hirsh-Pasek, 2016), yet many children with disabilities or delays, or dual language learners, may struggle to fully participate, access, and be included within play-based settings. A child's level of independence in the classroom is often considered an indicator of his academic success (Connell & Carta, 1993).

Assistive technology provides us with countless ways to support independence, specifically with the use of visual supports (Rao & Gagie, 2006; Raver, Hester, Michalek, Cho, & Anthony, 2013). Examples of effective visual supports include visual schedules to support open and close ended play related to a theme (e.g., photographs of block structures to build in the block area, a three-step play sequence of things to do in dramatic play, an independent play schedule for use at home), visuals to support peer interactions (e.g., turn taking, negotiating a conflict, initiating play with a peer), or visuals that demonstrate things a child can do or explore independently (e.g. photographs of toys, a four-step sequence for getting dressed). The alignment with AT for independence and both NAEYC's Developmentally Appropriate Practice, DEC's Recommended Practice, and the CEC High Leverage Practices are outlined in Figure 3.

Assistive Technology for Independence

Aligned NAEYC DAP Guidelines

- 2E: Teachers plan the environment, schedule, and daily activities to promote each child's learning and development.
- 2G: Teachers know how and when to scaffold children's learning - that is, providing just enough assistance to enable each child to perform at a skill level just beyond what the child can do on his or her own, then gradually reducing the support as the child begins to master the skill, and setting the stage for the next challenge.
- 2J: Teachers make experiences in their classrooms accessible and responsive to all children and their needs - including children who are English language learners, have special needs or disabilities, live in poverty, or other challenging circumstances, or are from different cultures.

Aligned DEC Recommended Practices

- E1: Practitioners provide services and supports in natural and inclusive environments during daily routines and activities to promote the child's access to and participation

in learning experiences.

- E5: Practitioners work with families and other adults to acquire or create appropriate assistive technology to promote each child's access to and participation in learning experiences.
- INS4: Practitioners plan for and provide the level of support, accommodations, and adaptations needed for the child to access, participate, and learn within and across activities and routines.

Aligned CEC & CEEDAR Center HLPs

- HLP 8: Provide positive and constructive feedback to guide students' learning and behavior.
  The purpose of feedback is to guide student learning and behavior and increase student motivation, engagement, and independence, leading to improved student learning and behavior. Effective feedback must be strategically delivered and goal directed; feedback is most effective when the learner has a goal and the feedback informs the learner regarding areas needing improvement and ways to improve performance. Feedback may be verbal, nonverbal, or written, and should be timely, contingent, genuine, meaningful, age appropriate, and at rates commensurate with task and phase of learning (i.e., acquisition, fluency, maintenance). Teachers should provide ongoing feedback until learners reach their established learning goals.
- HLP 19: Use assistive and instructional technologies.
  Teachers select and implement assistive and instructional technologies to support the needs of students with disabilities. They select and use augmentative and alternative communication devices and assistive and instructional technology products to promote student learning and independence.

Figure 3. *Alignment with professional organization guidelines/recommended practices in using AT for independence*

As with all interventions, teachers should begin by determining the need for the assistive technology by asking the following questions.

- Is this a tool that will help a child remain engaged while their caregiver is occupied at home?
- Is this something that will support a child in expanding their play repertoire?
- Is this a tool that will help the child engage in a back and forth play interaction with a peer?
- Once teachers have determined what interactive behaviors they want the assistive technology to support, we can move forward with the form of this technology (for more information on using visual supports in early childhood classrooms, see Gauvreau & Schwartz, 2013).

In many cases, low tech strategies (such as visuals, photos, schedules, etc.) are just as effective and, in many cases, more sustainable and implementable for teaching

teams that higher tech strategies (such as video modeling). As children's vocabulary increases, however, it is often necessary to move to a high tech communication system that can accommodate hundreds of words, compared to a PECS Book (Bondy & Frost, 1994; Schwartz, Gauvreau, & Bateman, 2019).

Once teachers have determined the appropriate AT for meeting the needs of the child, the next step is to teach children how to use this technology to be more independent. In order to ensure that children learn to use their AT device as designed, special educators must teach children how to use it and provide opportunities for practice with feedback (Campbell, Milbourne, Dugan, & Wilcox, 2006). A final step is embedding the assistive technology within the play based activity. This may include introducing a *my turn* or *wait* card within the context of a simple board game, or encouraging a child to use a sentence strip with a friend's photo and a picture symbol of the sensory table to ask them to play in that area. If teams are using more high tech assistive technology, this would include showing a child or a group of children a video modeling clip of how to play a group game before recess. As with all interventions, teams should make instructional decisions based on what the child needs and monitor progress to determine if the intervention is effective (Gauvreau & Schwartz, 2013).

Miss Rosa and her team select both high and low assistive technology to support student interaction. They create a play schedule for Alex, a young boy with Autism, who struggles to remain engaged in play during free choice. Alex's schedule includes picture symbols of areas of the classroom (e.g., blocks, sensory table, art, dramatic play, books). They teach Alex to select the areas where he would like to play that day, build his schedule by attaching the symbols to the scheduling using a velcro strip, and follow the schedule by going to each area of the classroom. To support Josie, a dual language learner with a developmental delay, in playing board games (one of her favorite activities), they create a visual with the symbol for "my turn" on one side, and the symbol for "wait" on the other. Teachers model how to use this visual to take turns during games, then support Josie in using it independently as she plays Zingo with a two other children. Finally, to support all the children in learning how to play group games at recess more independently, they use video modeling to show a video of preschoolers playing Duck, Duck, Goose before recess, then lead the class in this group game. With the use of this assistive technology, they notice great improvements in play across many children in the classroom.

Conclusion

The use of assistive technology can enhance the learning experience for children with disabilities. In the inclusive preschool classroom, the use of assistive technologies can enable young children to participate in play with their non-disabled peers. In order to support the needs of all preschool children, we recommend the use of AT for (a) communication, (b) mobility, and (c) independence.

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