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Children and Autism Spectrum Disorder: The Developing Role of Technology in Teaching Communication Skils

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Abstract

Children diagnosed with autism spectrum disorder (ASD) often struggle to learn effective communication skills. Researchers have asserted that the best methods for teaching correct communication skills to these children involve technological tools, such as videos, music, and graphics. Implementing these tools into the public school systems and the homes of children with ASD has been shown to improve their development of communication skills and includes educating teachers and parents about the positive effects that utilizing the tools can bring to the daily lives of children with ASD. When and how to implement these tools may depend on a child's level of functioning, and researchers have suggested that further study of children diagnosed with ASD in terms of both their physiological and psychological functioning might identify the appropriate time to begin implementing the tools for communication skills development that have the most effective outcomes.

Keywords: autism spectrum disorder, technology, children, Picture Exchange Communication System, public school systems

According to the Center for Disease Control and Prevention (2015), 1 in 68 children are diagnosed with autism spectrum disorder (ASD). The 5th edition of the Diagnostic and Statistical Manual (DSM-5; American Psychiatric Association, 2013), indicates that Asperger's syndrome, pervasive developmental disorder, autism, Rett syndrome, and childhood disintegrative disorder now all belong to the diagnosis of ASD, although the terms Asperger's and autism are still commonly used. Without any current medical treatments to cure ASD, the developmental impairments included in the disorder make life more challenging for both the child and his or her parents. One of the greatest struggles children diagnosed with ASD experience is the inability to communicate effectively. Although this is not always the case (high-functioning children with ASD tend to communicate better), most children with ASD have to be taught communication skills that typically developing children readily learn from infancy. While researchers have made many breakthroughs in understanding how to effectively teach communication and other social skills to children with ASD, little is known about successful strategies for implementing technology as part of those instructions.

Research studies about the effects of using technology in teaching children with ASD have emerged within the last few years. Most of these studies have involved the use of graphics and symbols to teach the children communication skills. One study incorporated a song with graphics to enhance the children's comprehension of the skills being taught (Simpson & Keen, 2010). However, the principal interest of most research studies involving technology and ASD is the effectiveness of the Picture Exchange Communication System (PECS). These study replications are not only taking place in the United States, but across the globe as well. Conclusions being drawn from these diverse studies are demonstrating that technology can be used to help children with ASD worldwide develop better, if not normal, communication skills. Such research has shown which teaching tools involving technology are most effective, how to best implement those tools in education systems and in the home, and the importance of determining when and how to implement these technological teaching techniques based on a child's level of functioning.

Effective Technology-based Teaching Tools

In the past few years, researchers have discovered multiple teaching tools utilizing technology that appear to

enhance the communication skills of children with ASD, such as the PECS, point-of-view video modeling, and interactive music embedded with graphic symbols (Simpson & Keen, 2010; Tetreault & Lerman, 2010; Travis & Geiger, 2010). These tools have shown increases in children's abilities to request, comment and express verbal utterances, which are included in the definition of effective communication (Ali, MacFarland, & Umbreit, 2011; Travis & Geiger, 2010). With this emerging empirical evidence, educators, psychological professionals, and parents can learn how these tools may enhance the development of communication skills in children diagnosed with ASD.

The Picture Exchange Communication System

The PECS is a six-phase learning system that teaches children to first communicate a specific message using a single picture, then gradually progresses to communication with multi-picture sentences (Ali et al., 2011). This system is used for children who have difficulty forming words into complete sentences by allowing them to instead use pictures that match what they are trying to communicate. Travis and Geiger (2010) conducted a pilot-study in South Africa in which children previously diagnosed with ASD were taught communication skills using the PECS over the course of nine weeks. Post-training sessions also took place to measure

continuing use of the skills learned during the PECS training. The results showed that the children's abilities to speak and form clear sentences and to respond through speech alone or speech with a picture improved significantly due to the PECS training (Travis & Geiger, 2010).

Another study which consisted of children with multiple disabilities, including ASD and visual impairment, also demonstrated positive results. Using a similar methodology as the one used by Travis and Geiger (2010), Ali and colleagues (2011) concluded that each of the children who took part in the study learned how to properly request items and maintained this skill after the PECS training. The children were also able to generalize those skills in natural settings, such as their classrooms. However, because each study only utilized two to three children due to a lack of eligible and cooperative participants, small sample sizes limit the applicability and generalizability of these findings.

Despite sample size limitations, these results provide significant evidence for a need to renovate educational structuring for children with ASD. By incorporating communication systems such as PECS into public school systems, children with ASD can achieve the most effective results to enhance their communication skills. And while the

PECS system used in these studies did not specify whether or not digital versions of the pictures were used, a strong likelihood exists for using technological means, such as iPads or Interactive Whiteboards (IWBs), in place of tangible pictures. These resources could also become more available at this time because of the prominent advancement of technology replacing tangible learning tools such as books and physical pictures in both home and school settings.

Video Modeling Tools

Another tool being investigated by researchers is point-of-view video modeling (POVM), a system wherein children watch a video demonstrating a certain social skill—such as asking for help from an adult—and learn from the video how to communicate a given script with an adult conversant. Video modeling (VM) is a similar technique in which children watch a video to learn a social skill, but the adult conversant initiates the following conversation instead of the child. Some researchers have stated that VM can be more effective than other methods because it reduces irrelevant stimuli and allows the children to exert greater focus on the relevant communication cues being taught in the videos (Charlop-Christy, Le & Freeman, 2000; Krantz, MacDuff, Wadstrom, & McClannahan, 1991). However, other researchers claim POVM is even more advantageous

than VM because POVM further restricts irrelevant stimuli during training, allowing the child to focus directly on the behavior being demonstrated in the video (Tetreault & Lerman, 2010). This greater focus also allows children to quickly understand the optimal characteristics of the model behavior without requiring the adult conversant to explain those characteristics to him or her (Hine & Wolery, 2006). Thus, without the video and the personal interaction with the adult conversant, the children would not learn as proficiently how to generalize the communication skills taught by the video.

One study with findings that are incongruent with the above conclusions is that done by Tetreault and Lerman (2010), which focused solely on POVM. These researchers found inconclusive results with three children diagnosed with ASD. The researchers examined behavioral skills (eye contact and making a statement before the adult conversant spoke to them) that had not been examined in previous POVM or VM research but found the children's levels of behavioral skills at the end of the study were not significantly different from their levels of behavioral skills before the study, thus generating ambiguous results concerning these tools working for the acquisition of specific behavioral skills. Although flawed, these results highlight

the gap in current research concerning the effectiveness of teaching children with ASD communication and behavioral skills through the usage of technology. Therefore, it is critical that such research be examined and replicated to extricate the unsuccessful components and replace them with the most beneficial tools for the development of communication skills for children with ASD.

Embedding Music in Teaching Communication Skills

Music is a commonly used teaching tool for toddlers and children because of its ability to simplify concepts using repetitive melodies and lyrics. Music is also used in many forms of media, such as television and movies, to teach children various concepts. Researchers have shown that when music is implemented in the education of a child diagnosed with ASD, his or her learning increases on a par with normal-functioning children.

Simpson and Keen (2010) focused on autistic children's ability to maintain motivation for learning. The researchers hypothesized that when graphics were embedded into interactive songs to teach young children with autism the names of animals, the children would be able to correctly identify an animal more easily with the music than without it. Specifically, they concluded that the children more effectively learned the names through the interactive

use of music in PowerPoint slides and on an IWB. In contrast, the children in the "no music" control group did worse at identifying the animal names presented. Exposure to music, changes in the presentation of names, and repetitive sequences of presentation led to higher rates of correctly identifying the symbols (Simpson & Keen, 2010). Such characteristics have also been shown to be appealing to developing toddlers and assist with their memory recall (Ellis & Blashki, 2004; Ricks & Wing, 1975). Simpson and Keen's (2010) usage of PowerPoint slides, an IWB, and interactive music demonstrates how significantly technology is influencing the world of research, and how technology can enhance the effectiveness of children's learning environments. With discovering through empirical research that incorporating technology into teaching communication skills to children with ASD considerably improves those skills for them, the capacity for improved teaching tools can be further researched and developed into globally practiced programs to advance the lives of children with ASD worldwide.

Implementation of Technology-based Learning in Public School Systems and Homes

Researchers who studied children diagnosed with ASD have shown that the use of technology can increase the

learning of communication skills for this population. Subsequently, these researchers have called for further research to involve (a) comparative studies that identify the most effective interventions, (b) larger samples to ensure generalizability, (c) the identification of interventions that are most effective for different age groups and spoken language abilities, and (d) implementation of these interventions in the home (Ali, et al., 2011; Travis & Geiger, 2010). These interests highlight the two settings—school and home— where children spend most of their time and obtain most of their knowledge. These settings are also where children diagnosed with ASD utilize their communication skills the most through social interactions with their peers, teachers, and family members.

Implementation in Public School Systems

Research conducted in public school districts in Georgia (Hess, Morrier, Heflin, & Ivey, 2008) included a series of categories to define the level of intervention used in a classroom: (a) Interpersonal Relationships, (b) Skill-based, (c) Cognitive, (d) Physiological/ Biological/Neurological, and (e) Other (see Simpson et al., 2005, for a further description of the categories). The researchers then surveyed multiple teachers in different grade levels about the intervention techniques used in their

classrooms for students with ASD. The results indicated that most of the techniques used by both regular and special-education teachers were less than effective for instructing that student population. Nearly one-third of the techniques the teachers used were not scientifically based and, in the researchers' opinion, should not have been utilized (Hess et al., 2008; Simpson et al., 2005). Such results further emphasize the need for research to be conducted using teaching techniques that can be used for both normal-functioning children and those with mental development disorders like ASD. And because most educators know or are learning the current technological teaching methods for normal-functioning children, they will begin to utilize those methods for students diagnosed with ASD as well once research has sustained the effectiveness of those teaching techniques for all types of students.

Implementation in the Home

The involvement of parents in the education of a child with ASD is a crucial aspect of the effectiveness of his or her education. Children whose parents are involved in teaching within the home learn more efficiently than those without comparable parental involvement (Ingersoll & Dvortcsak, 2010; Simpson et al., 2005). When parents use interactive, direct teaching approaches that encourage

communication skills development, such as allowing the child to initiate interaction appropriate to parental responses, the child will more effectively generalize those skills in other social settings. The results from these studies also indicate that these teaching techniques within the home are most beneficial when incorporated into a daily routine, such as during meal and play times (Ingersoll & Dvortcsak, 2010). These results suggest the significance of children with ASD learning communication skills in other settings besides school. Because skills like communication are generalizable to so many different settings, the children need to learn how to effectively utilize and improve those skills through practice in multiple settings and thus simultaneously improve their behavioral and social skills.

Implementing Teaching Techniques Based on Level of Functioning

Children diagnosed with ASD are typically given a label of low-functioning, moderate-functioning, or high-functioning. Little research exists about the methods of teaching communications skills appropriate for level of functioning in children diagnosed with ASD. Future research needs to assess this component with new and current teaching methods, while also separating participants into distinct groups based on level of functioning. If

researchers can discover which techniques are best suited for each distinct level of functioning, improvements in the teaching and learning of communication skills for children diagnosed with ASD could increase dramatically through such customization.

Watson, Baranek, Roberts, David and Perryman (2010) focused on child-directed speech (CDS) and physiological factors of children with ASD to predict their ability to communicate effectively as they grew. CDS, also known as "baby-talk," is a simplified communication style that parents and other caregivers often use with children. Researchers have previously noted that this communication style is helpful for children diagnosed with ASD due to its repetitive nature, elongated vowels, greater pitch range, and shortened sentences that allow them to pay greater attention to the communication (Fernald, 1993; Werker & McLeod, 1989). Watson et al. (2010) also recorded the participants' respiratory sinus arrhythmia (RSA). Previous researchers had reported that when RSA was higher in non-challenging, calm conditions, the more likely one was to experience greater sociability (Fox, 1989; Porges, Doussard-Roosevelt, Portales, & Suess, 1994).

Watson et al. (2010) found a positive association that existed longitudinally between RSA and the communication

skills of children with ASD, which suggests that the physiological regulation of attention to CDS can influence the continual development of communication skills for children diagnosed with ASD. Furthermore, the association of RSA during CDS exposure for children diagnosed with ASD suggests that they make physiological adjustments during the CDS conditions that are important in their processing of language; however, these results did not concur in nonsocial stimuli situations. With these findings, further testing could be conducted on children with ASD to determine when implementation of learning communication skills with technological tools would be best based on their physiological reactions to specific communication styles.

Conclusion

With the rates of ASD diagnoses in children increasing rapidly, the demand for the improvement of interventions for difficulties with communication skills (a common symptom of ASD) is rapidly increasing as well. The focus in research to date has been on improving the teaching of communication skills to children diagnosed with ASD because the proper development of communication skills allows these children to in turn increase their behavioral and social skills. The little published research that exists about the use of technology in teaching

communication skills to children diagnosed with ASD has shown increases in the acquisition of those skills. Therefore, further research in the areas of teaching children diagnosed with ASD, and possibly other mental development disorders, must begin to involve technology. With the prevailing growth of these technological learning tools in social contexts like public school systems and homes, the availability for children diagnosed with ASD to learn communication skills more effectively increases with that growth. If these technological teaching mechanisms were implemented into the lives of all children diagnosed with ASD, their communication skills could develop more quickly and more effectively with rather than without these technological tools. And with significantly improved communication skills, improvements in social and behavioral skills appear to follow suit. Implementation of proven technology-based teaching tools for communication skills development may be the most effective approach to narrowing the gap between communication acting as a social barrier and communication becoming a social facilitator for children diagnosed with ASD.

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