CHAPTER 5

Classroom Use of Video Games for Children with ADHD and Autism Spectrum

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Key Summary Points

1. Video games have vast potential for helping with the academic, social, and emotional education of children with ADHD and autism.
2. There are legitimate concerns about negative outcomes for the use of video games and technology for children with ADHD and autism spectrum disorders.
3. Video games and technology can be useful for training executive functioning, adaptive and behavioral, and social/emotional skills through the use of short-form and long-form games.

Key Terms

Autism apps
ADHD and video games
Executive Functions Technology
Generalization of Game-based Learning
Video Games
LearningWorks for Kids
TeachTown

Introduction

Children with developmental disorders such as Attention-Deficit/Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) are characterized by difficulty in the generalization of learning from one setting to another. They often experience problems with sustained attention and effort; the capacity to connect classroom learning to the real world; and a variety of executive-functioning skills, including organization, planning, metacognition, social thinking, and flexibility. Traditional classroom methods

for teaching children with ADHD and ASD are often ineffective due to students' lack of engagement; difficulty with expressive and receptive communication skills; behavioral and emotional problems; or physiological difficulties, including sensory or fine-motor struggles.

Video games, apps, and other technologies have opened new opportunities to teach children with ADHD and ASD due to characteristics of digital media such as multimodal feedback and adapting challenge to mastery levels, as well as students' willingness to engage, practice, and master these tools. Teachers have increasingly observed the dramatic contrast between the enthusiasm and persistence for learning with digital tools as opposed to traditional educational strategies with special needs students and have begun to use games and apps in their classrooms. Educators are also recognizing the vast potential for using games, apps, and other interactive media to teach a variety of problem-solving, communication, executive-functioning, and academic skills to children with ADHD, ASD, and other social and emotional difficulties. At the same time, possibilities of addiction, overuse, and withdrawal from social relationships reflect legitimate concerns about the use of digital technologies with children with developmental disabilities.

The use of technologies in the classroom for children with ADHD and ASD is in its infancy. The majority of school-based studies (Whalen et al., 2010; Durkin, 2010) have focused primarily on software designed specifically for a particular population. However, the use of popular games and apps designed for all children, which are often more engaging in nature, is now a common source of instructional material. With the advent of mobile apps, the concept of using a variety of smaller or short-form games or apps as opposed to a single, large program is also being explored in the classroom.

Key Frameworks

Definitions and treatment of ADHD and ASD

ADHD is characterized by difficulty with inattention, distractibility, and/or hyperactivity that impairs performance in school, at home, or in other activities. ASD is characterized by developmental difficulties that can include problems with social interactions, communication, and restrictive patterns of behavior. The use of games, apps, and other technologies as treatment approaches for both ADHD and ASD is in its infancy. While there are generally not any accepted frameworks for using technology as an intervention for either of these psychiatric disorders, there are many widely evidenced-based interventions for children with these types of developmental disabilities. Traditional strategies that are successful share many characteristics with interventions that rely upon the use of digital media and technology.

What makes video games powerful tools for teaching children with ADHD and ASD?

There are widely accepted fundamental educational approaches for children with developmental disorders. Many of these constitute "strategic teaching" principles that can be used in the classroom and by parents and clinicians. Common to strategic teaching principles are procedures that use individualization, metacognition, and generalization approaches.

Traditional strategies for teaching children with ADHD involve the use of point-of-performance interventions that address a particular problem or skill right at that time. Immediacy and salience of the feedback are extremely important in interventions for ADHD (DuPaul & Stoner, 2004). Feedback needs to be powerful and meaningful to the individual. Multimodal feedback that includes multiple intervention agents; opportunities for movement; and the capacity to be able to talk, get feedback, or fidget may also be helpful. Given the disabilities of children with ADHD, it is evident how specific characteristics of digital media and video games can be very useful in helping them.

Table 1. *Video Game Characteristics and Children with ADHD*

Characteristics of Children with ADHD or Attention Difficulties	Characteristics of Video Games and Other Digital Media
May easily become bored and unable to sustain attention.	Good video games and other digital media are often multimodal, requiring ever-changing skills and employing a variety of stimuli, including video, sounds, words, and actions, that help keep children interested and engaged.
Often require reinforcement or consequence that is immediate to stay focused on a task.	Video games provide clear and immediate feedback, constantly letting players know what they are doing wrong and what they are doing right.
Often require their bodies or minds to be actively engaged.	Video games and other digital media are extremely engaging, and many require physical and cognitive involvement.
Usually have problems with following directions.	Video games teach by trial and error or through guided discovery, requiring players to understand instructions to succeed.
May struggle to learn new information and experience frustration or low self-esteem as a result.	Most negative feedback from video games and other digital media occurs privately. This causes less embarrassment and frustration while teaching players how to handle these emotions.

Traditional strategies for teaching and improving skills in children with ASD include direct instruction in social skills; occupational and physical therapy to help with sensory integration and motor-coordination problems; and training in communication skills such as listening, making eye contact, and reading nonverbal cues. Family and individual therapy may also be helpful, along with executive-functioning training to improve cognitive flexibility and adaptability. Some specific strategies and tools are used to train children who have more severe forms of ASD. These include approaches such as applied behavioral analysis (ABA) (Lovaas, 1987), which is a form of behavior modification that assesses the relationship between a behavior and the environment and develops strategies to reinforce appropriate behavior. Autism researchers (Whalen et al., 2010) have also identified motivation, attention, and flexibility as important tools to teach children with ASD. Given the disabilities of children with ASD, it is evident how specific characteristics of digital media and video games can be very useful in helping them.

Table 2. *Video Game Characteristics and Children with ASD*

Characteristics of Children with Autistic Spectrum Disorder	Characteristics of Video Games and Other Digital Media
May be inflexible or rigid and struggle with changes or making mistakes.	Video games help children practice being flexible in a safe and engaging environment through learning the rules of the game by trial and error and guided discovery.
Are often unaware of social cues and convention.	Massive Multi-player Online Games are particularly good for becoming part of a group and require that players learn the "customs" of the game world, allowing children with autism to socialize in a more comfortable environment.
Often display poor fine- or gross-motor coordination.	All video games practice some degree of fine- and gross motor-skills, particularly those with motion controls.
May become vulnerable to bullying and not understand when they are being teased or how to protect themselves.	Many online multi-player games contain the same types of social interactions children find at school, both the good and the bad. Parents can sit with their children (without the other players knowing) to coach them through any difficult social interactions that may occur.
Often do not share common interests with peers.	Most children play at least a few video games, so having a knowledge of gaming would give children with autism a topic of conversation to use with their peers.

Case Study One: Playing Smarter Program

Playing Smarter is the school-based curriculum of video games from LearningWorks for Kids, an educational technology website that reviews hundreds of popular video games and digital technologies to teach executive-functioning and academic skills to children. The games selected for the Playing Smarter program are a small subset of the larger set of popular video games and apps used by LearningWorks for Kids. Examples of Playing Smarter games include *Learn to Fly*, an action game in which players help a penguin fly by using rockets, gliders, and various aerodynamic tools; *Chuzzle*, a tile- matching video game; and *Red Remover*, a puzzle game in which players must make all the red blocks disappear from the screen without losing any green blocks. Each of these games demonstrates multiple, concrete examples of a particular executive function, allowing users to practice applying the skill, which can inspire thoughtful discussion about the skill after it is played. Playing Smarter focuses on the use of Internet-based games that do not require particular consoles.

Teachers are encouraged to play the games in a school environment for at least 30 minutes to become familiar with game mechanics and to experience how they use an executive-functioning skill. Playing longer can help in the development of a better sense of how to direct students. Because the program is school-based, issues regarding appropriateness for classroom, length and complexity of the games, and accessibility are also considered.

The popular, short-form games are accompanied by other learning tools that help promote generalization of the skill. Each game has its own web-based guide, referred to as a "Playbook." The Playbook consists of a preview of the game, called a "PrePlay," which describes the skills that will be practiced in the game. The PrePlay, presented prior to playing the game, informs students about how the executive skill is used in the game and asks them to make predictions and/or set personal goals. It is intended to direct the focus of game play toward discovering and practicing the executive skill rather than simply getting a high score. After playing the game students complete the Playbook "RePlay," which allows them to rate the game based on their enjoyment, cite examples of when they used the executive skill, and make connections between the game and real-world situations that require that skill.

Hands-on connection activities follow each game that require students to transfer the skill from the game to an activity such as *Memory Match* or *Scattegories*. Along with the RePlay, these activities provide specific, real-world situations of where students might use the executive skill they have practiced in the game and help to demonstrate their versatility. Classroom discussions (and Playing Smarter teacher guides) are directed toward generalizing the game-based skill to problem solving, academic study, and 21st century skills.

Each game in Playing Smarter can be used as a single lesson or multiple games can be grouped to create a customized series of classroom lessons that target a specific skill, as was done during the described (2011) research study. Playing Smarter can also easily be adapted for a differentiated instructional model where students work on an individual area of weakness and discussions are primarily between the student and instructor or special educator.

Two consecutive, three-week sessions of the Playing Smarter program were conducted during July and August 2011 with a population of students diagnosed with ADHD through a full neuropsychological battery. Playing Smarter targeted improving awareness and application of three executive functions particularly important in ADHD: focus, flexibility, and planning. Each session took place over a period of three weeks — one week per thinking skill —with eight hours of instruction a week. Challenges that were experienced during the first session were evaluated prior to the start of the second session, allowing the instructors to improve the delivery of the content. The goal of the pilot studies was to find the best methods to use the engagement of selected popular video game play to practice and understand executive-functioning skills and then to generalize these skills to academic or everyday-life scenarios where alternative learners tend to struggle.

At the conclusion of the Playing Smarter study students were asked to generate examples of each thinking skill in both the pre-testing and the post-testing. Students were given a point value based on the clarity of each response. Broad or generalized answers were given one point, while specific examples with context were given two. Irrelevant or repeated responses were not counted in the total. On average, students scored six points higher on the post-test, and collectively both sessions saw an increase in responses indicating that they were able to identify more examples of how each skill is applied outside of digital technologies. Parent pre and post measures were not significant for change, although this could be attributed to the small (ten students) sample size.

Overall, the experience gained from this research study indicates several important things to keep in mind when using digital games as teaching tools for children with ADHD. First, the games are exciting and motivating for students but have the ability to overshadow the bigger picture. Students were more likely to remain focused on the goal of practicing a particular skill and applying it elsewhere by using other engaging learning activities surrounding game play. However, the game cannot be used solely as a reward but should be treated as a valuable tool for learning so that students will see it as such. Modeling and think-aloud strategies can help eliminate confusion associated with adjusting to a new digital technology and help all students to start with the same level of background knowledge. In addition, learner-centered teaching strategies such as setting up teams of players had a positive impact on the motivation and focus of the students. Future research is planned with a larger sample of students and with materials available online.

Key Findings

Much of what clinicians and parents know about ADHD children's use of video games is anecdotal and observational in nature. Parents frequently report that their children with ADHD play video games too much and too intensely (Durkin, 2010). However, they also observe the capacity for sustained effort and attention to video games in their children with ADHD, sometimes calling into question whether the children do in fact have ADHD if they can focus so diligently on a video game.

Most of the data suggest that children with ADHD are similar to their typically-developing peers in their use of games and apps. For example, Bioulac (2012) found no evidence of a significant difference in the frequency or duration of play between ADHD and typically-developing children ages ten to 12 years old. However, recent data collected by Linginerni (2012) indicated that 90% of children with ADHD children spend more than one hour a day on the computer compared to only 80% of typically-developing children. Data collected by Kulman (2012) indicated that video games are the second most-used technology after television for children with ADHD, in contrast to typically-developing children, for whom they come third after music.

There is also evidence that children with ADHD may play games somewhat differently than their typically-developing peers. An early study by Lawrence (2004) indicated that children with ADHD completed fewer challenges and were less able to develop novel problem-solving strategies in video games and subsequently had fewer items named correctly on the Stroop Color Word Test. This was hypothesized to be related to slower processing speed, which is frequently a characteristic of ADHD.

A study that used the video games *Crash Bandicoot* and *Frogger* to investigate inhibitory performance of children with ADHD found no difference between ADHD and typically-developing children (Shaw, 2005). When neuropsychological tests were made into more video game-like tasks, children with ADHD were found to make significantly fewer errors (Shaw, 2005). Similarly, children with ADHD were found

to perform much better on working-memory training programs that use game-like elements to enhance motivation and training efficacy (Prins et al., 2011).

There are data that suggest that children with ADHD tend to perform better with video games or digital technologies than they do on paper-and-pencil tasks. A study that compared computers to analog technologies on versions of the same neuropsychological testing found that children with ADHD performed better on the Wisconsin Card Sorting Test computerized version as opposed to a traditional deck of cards. This finding is in contrast to that of typically-developing children, whose performance was the same on both measures. Children with ADHD were able to close the gap with typically-developing children when they were able to use the computerized version of this test (Oznoff, 1995).

There are also studies suggesting that video game play can be associated with negative outcomes for children with ADHD. Tahiroglu (2010) described the deteriorative effects of computer game play on children with ADHD, Inattentive Type in a correlational study of high- and low-duration players. Gentile, Swing et al. (2012) found that the amount of time spent playing video games was associated with greater attention problems in the same way demonstrated by previous research on television. Gentile's longitudinal study found that television/video game play was associated with attention problems in middle school and late-adolescent samples. It should be noted that the studies were correlational and that attention problems were measured by a three-item scale from teachers. A recent study of *SpongeBob Squarepants* (Lillard & Peterson, 2011) found that only nine minutes of viewing resulted in deterioration in executive-functioning skills, although this study was also very limited.

Video games and other digital tools have demonstrated promise in improving a variety of executive functions (brain-based self-management skills such as working memory, flexibility, organization, self-control) in children with ADHD. Tucha et al. (2011) utilized a computer training program called AIXTENT to train four different components of attention, including alertness, vigilance, and selective and divided attention, and found that there was generalized effectiveness in training on attention functioning. A number of studies indicate that video games can improve executive-functioning skills in children and young adults (Nouchi et al., 2013; Rueda, 2005). There is also ample evidence that video game-like technologies can improve working-memory skills, which are frequently identified as the single most important deficit observed in children with ADHD and are often a significant area of weakness for children with ASD. Studies conducted on Cogmed Working Memory Training, which utilizes a series of short memory-based video games (Klingberg, 2010), suggest that structural changes in the brain occur that lead directly to improvement in the symptoms of ADHD.

There are biological factors that make video game play such powerful for children with ADHD. Recent studies (e.g., Hoeft et al., 2008) suggest that video game play triggers dopamine release from the brain, which is consistent with how the neurotransmitter dopamine is important in rewarding behavior. Individuals with ADHD are described as having a dysfunctional dopamine system, resulting in problems in sustaining attention, oversensitivity to distractions in the environment, and difficulty with self-regulation skills. It has been hypothesized that they may seek out video game play in an effort to

increase dopamine release in their brains. A study by Hahn (2009) found slight reductions in Internet play over several weeks as participants with ADHD were treated with Methylphenidate. This study was interpreted to suggest that these individuals had a reduction in their need to be on the Internet because they had a diminished need for dopamine release as a result of the medication.

ASD and Video Game Play

As with our knowledge about ADHD children's involvement with video games, much of what we know about children affected by autism and their use of digital media is anecdotal in nature (Durkin, 2010). There are many reports that describe children with higher-functioning autism and Asperger's Disorder as being overly engaged in solitary technology and video game play. At the same time, there are also an increasing number of reports indicating that the use of apps and technology has dramatically improved the interactive and social skills of children affected by autism.

A ten-year prospective study conducted by Mazurek et al. (2011) indicated that the majority of youth with ASD (64.2%) spent most of their free time involved in non-social media, including television and video games, while only 13.2% spent time in using social media such as email, Internet, and chatting. The use of non-social media for groups such as those with learning disabilities and speech and language impairments was far higher among the ASD group compared to those with other disabilities.

A study by Shane & Albert (2008) indicated that children with ASD participated in screen-based activities with television and computer games more than other leisure activities and often did so to the exclusion of other activities. They found that 41.4% of children with ASD spend most of their free time playing video games and contrasted this to data suggesting that only 18% of typically-developing children in the general population were considered to be high users of video games. Mazurek & Engelhardt (2013) compared video game usage in children with ASD, ADHD, and typically-developing children. Their findings were similar to the anecdotal reports about the use of video games for children with autism or ADHD from many parents, that is, that many of these children become overly focused on their video game play, have difficulty transitioning from video game play to other activities, and may display argumentative behavior in an effort to have access to more video game play.

Swettenham (1996) suggested that there are three main reasons that children with autism are attracted to computers: computers involve no social factors, they are consistent and predictable, and children can take control and determine the pace of activity. This study, conducted in 1996, was done long before the prevalent social aspects of Internet technology but is supported by the type of media use seen in children affected by autism. Winters-Messier (2007) undertook an interview study with children with ASD that suggested that they are motivated by the skills and challenges of video games and escaping into a fantasy reality.

Interestingly, children with ASD may display specific visual-spatial strengths that draw them to video games, as well. They tend to find hidden figures more easily than typically-developing peers in an embedded figures test, suggesting that they might be better at video games involving hidden figures. This is in contrast to performing more poorly on tasks in which processing visual motion is necessary. Durkin (2010) also suggests that games involving planning, application of working memory and contextual memory, site shifting, inhibition of pre-potent responses, and fluency to adapt to change may hinder the performance of children with ASD.

There may also be biological and social factors that make video games such a powerful tool for teaching children affected by ASD. Mineo et al. (2009) describe research-based evidence of the strength of the visual modality among many individuals with ASD and suggest that the preference for visual stimuli, particularly those delivered via electronic screen media, may be better for teaching. Electronic screens may be ideal for teaching children with ASD because they have a relatively constrained viewing area that limits the attention frame, helping youngsters with ASD focus their attention on relevant stimuli and ignore irrelevant ones. Screens also provide predictability across repeated viewings, enabling viewers to anticipate upcoming scenes. When the auditory content is closely synchronized with the visual stimulation, multi-media information may assist viewers in the coordinated processing of information. Viewing electronic screens can also take place without the interference of another person, and this typically does not make social demands on those with ASD (Mineo, 2009).

Video games and other digital technologies also appear to be excellent tools for teaching social and communication skills to children affected by ASD. Bellani (2011) described using virtual reality and virtual environments to train children about social skills. This can be adapted to an individual child's needs and provide specific training, resulting in numerous improvements. Some recent apps have been identified as being extremely useful tools. Data related to Autismate indicate significant improvements in the understanding of social cues and development of specific communication skills.

Many children with autism experience difficulty with executive-functioning skills of flexibility, self-awareness, and self-control. Video games provide opportunities for developing fluid problem solving and cognitive flexibility due to the necessity to learn from mistakes. The skills of self-awareness and self-control required in many socially-based games may encourage children to want to learn these skills so that they are included with their peers.

Video games are also an excellent way for children with ASD to share interests with their peers. However, interview studies with children with ASD have indicated that their interest in video games may be somewhat more unusual than those of typically-developing peers. For example, they may have an interest in only one game that they play on a regular basis or play games that relate to their specific interests (Winters-Messiers, 2007). Anecdotal observations suggest that the games played by children with ASD are often less mature or of less interest to their same-age peers.

Classroom Use of Video Games for the Treatment of ADHD and ASD

The use of video games in the classroom for the treatment of ASD is becoming an increasingly accepted approach for improving communication and social skills. The games and apps used in the classroom are typically designed specifically for this population of children. Some of these tools are more game-like than others and may foster greater motivation and engagement in the part of students. The Center for Autism Research's FaceStation Project (2012), which requires repeated perceptual discrimination of facial identities and facial expressions, is an example of these types of games. Other games and apps such as *Go-Go* games, *ChoiceWorks*, and *Proloquo2go* were designed to help with tasks such as communication, scheduling, and learning visual-differential skills.

There is increasing interest in the use of popular, commercial, off-the-shelf video games for the treatment of autism, as well. Many schools have begun using the Microsoft Xbox Kinect for improving social and gross-motor skills. Because many video games require the use of and practice skills such as flexibility, self-awareness, and self-control, they may also be very powerful teaching tools for the development of these skills in children affected by ASD. Specific classroom strategies for using popular games to improve these skills can be found at websites such as www.learningworksforkids.com. Children's motivation, level of sustained interest, and willingness to overcome frustration to beat the games may make these powerful tools to improve the lives of children affected by autism.

Only a limited number of games have been developed that directly treat children with ADHD. Most of these specialized games and tools, such as *Cogmed Working Memory Training, Play Attention,* and *ADHD Therapy 360*, are available online. With the exception of *Cogmed Working Memory Training*, which is now being offered in dozens of schools across the country, there is very limited research that supports the use of these games for the treatment of ADHD.

An alternative approach that can be readily applied in the classroom is the use of popular video games (commercial, off-the-shelf games) for direct practice of the skills that are frequently core deficits in children with ADHD. Games that address skills such as working memory, planning, organization, time management, and focus have the potential to improve these abilities in children with ADHD, particularly if the skills can be generalized to transfer to real-world activities.

It is also important to consider the broader issue of the academic demands of today's schools in any discussion of the use of games in the classroom. Common core standards, availability of time to teach skills rather than content, and the degree of teacher knowledge and technology to use games in the classroom are vital considerations in this matter. Games and technology can offer opportunities for differentiated instructional approaches and novel teaching strategies in the classroom.

This chapter examines two strategies that can be employed to use different types of games in the development of these skills. Long-form games are more open-ended and may take place over many hours. The game *TeachTown* is explored as a long-form game designed specifically for the special needs population to teach social and communication skills to children affected by autism and other developmental disorders. Short-form games, which are often available online or on mobile devices

and can be played within a single class period, are also evaluated as a tool for teaching 21st century, executive- functioning, and creativity skills in the classroom. Short-form games are described by the Cooney Foundation report "Games for a Digital Age" (2012) as a potentially powerful tool for classroom teaching. The short-form program "Playing Smarter," which uses a variety of popular, casual games as teaching tools to develop executive-functioning skills, is appraised in its use in a classroom setting.

Case Study Two: *TeachTown* Basics

TeachTown is a computer-assisted instructional intervention that utilizes applied behavioral analysis to improve social/emotional, academic, and adaptive skills in children with ASD. The program is designed for students with ASD who are between the ages of two to seven years developmentally. *TeachTown* helps develop adaptive skills such as understanding household vocabulary and money identification, along with social and emotional skills such as understanding emotion synonyms, gesturing, and emotion causes.

TeachTown uses applied behavioral analysis techniques (ABA) for the development of social and language skills. The program employs computer-assisted instruction with computer-based rewards of playing with animated pictures in between trials. It uses a discrete trial model where students respond by selecting an image in response to an instructional cue. The correct response elicits a positive statement such as, "You did it!" An incorrect response is followed by a presentation of the correct response.

Some of the more powerful features of *TeachTown* are strategies for generalization of skills. Within the program is the use of multiple exemplars, with each skill or specific piece of content-based knowledge that is presented replicated with an array of images and words to describe it. For example, if children are learning to recognize an airplane they see a variety of images portraying pictures of airplanes to help them generalize the content or feeling. Perhaps even more important are the non-technology based activities to improve generalization of skills. *TeachTown* provides teachers with motivating activities that practice the skills being taught in the computer-assisted instruction with classroom or home-based activities.

Research conducted with *TeachTown* (Whalen et al., 2006) suggested that *TeachTown* enhanced social-communication skills and decreased inappropriate behavior. A later study (Whalen et al., 2012) that included 90 students in a special education classroom found that children who averaged 23 hours using the *TeachTown* software made a variety of social and emotional gains. The results suggested that students in the treatment condition made significantly greater gains than the control group on seven out of ten learning domains on the Brigance Inventory of Early Development II. Furthermore, the more time they spent on *TeachTown* basics, the higher the score was on this measure.

Overall, the *TeachTown* research describes the promise of using computer-assisted instruction for the improvement of social/emotional and learning skills in children with ASD. The data suggest that this type of program can reduce the need for one-on-one teaching with these children and be suitable to a variety of special needs students rather than just those with ASD.

Assessment Considerations

Assessment of ADHD is generally conducted through an extensive clinical psychological interview, the collection of parent and teacher rating forms, and a comprehensive neuropsychological evaluation. Using a limited selection of these tools in a pre/post fashion is helpful to assess the impact of game and app interventions.

Pre and post measures such as the Conners' Continuous Performance Test III (CPT III) are often used to determine the effectiveness of the treatment of ADHD, whether through the use of video games in the classroom or a behavior management strategy in the home. Given that interventions using technology to improve the symptoms of ADHD are often targeted at specific skills or subcomponents of ADHD, it can be more important to measure improvement in these selected skills, requiring assessment of executive functions such as working memory, sustained focus, organization, task initiation, and time management. The skills are defined in scales of executive functions such as the Behavior Rating Inventory of Executive Functions (BRIEF), which are currently the best methods to assess the impact of video games and apps to improve the symptoms of children with ADHD.

Similarly, assessment of children with ASD requires historical data, observations, parent-teacher reports, and neuropsychological testing. In this case, pre/post assessment necessitates a focus on very specific skills due to the variability of diagnostic criteria.

As in the case of ADHD, it is appropriate to assess specific skills that video games and apps might improve in children affected by autism. For example, social-awareness skills, communication, metacognition, and cognitive-flexibility skills are targeted by many of the apps and technologies that have been developed for children with ASD. Assessing improvement in these areas is best done through collection of pre and post test data. Tests that measure speech, language, and communication skills may be helpful as broad-based measures. Rating scales completed by parents and teachers such as the BRIEF, which looks at executive-functioning skills, or the Autism Spectrum Rating Scales (ASRS), which evaluates very specific symptoms of ASD, are currently the best tools to assess real change. Most neuropsychological test measures that assess similar concerns are generally less sensitive to short-term change, so instruments such as the Wisconsin Card Sorting Test, a measure of cognitive flexibility, may show very little change even though the child has developed a variety of new skills through his game and app use. No assessment tools have been developed to look specifically at the impact of video games and apps on the performance of children with ADHD and ASD. However, applying the available rating scales and targeted neuropsychological test measures can help in determining the impact of classroom-based use of games and apps for children with ADHD and ASD.

Future Needs

Cautions and Concerns

There are legitimate reasons to be concerned about the use of video games among children with developmental disabilities. While the evidence is overwhelming that many popular games and apps can be helpful in developing skills in children with ADHD and ASD, there are also data that higher rates of video game addiction, conflicts around transitions and stopping video game play, and high levels of frustration can be observed.

The perils and potential of video games for children with ADHD are evident in the current research in this area. The prominence of digital media in the lives of young people with ADHD is only likely to increase in the future, so further understanding of how to use technologies such as video games productively becomes even more important.

Children with ADHD often become hyper-focused on areas of interest, and this frequently happens with video games and other digital media. This may cause them to neglect other important responsibilities such as school and chores. Children with ADHD or other attention problems can become so absorbed in activities that they lose track of how much time they spend on digital play and display poor time-management skills. These youngsters may also choose to engage in digital play instead of the physical activities that are particularly important for them, as exercise leads to improved focus and concentration.

Because children with autism often struggle in social relationships they can be overly drawn to single-player games and immerse themselves on the Internet. They may also become so comfortable in online social settings that they lose sight of the importance of face-to-face communication and withdraw even further from their peers. Children with ASD are easily obsessed and may perseverate in many aspects of their lives, becoming overly engaged in playing a particular game beyond the point where they gain any benefit from it.

Video games for children with autism can present a host of dangers and the potential for problematic use. Mazurek & Engelhardt (2013) found that children with autism tend to have particular difficulty when they use role-playing games such as *Pokemon*. Role-playing games have particular game features such as high reward schedules (including virtual rewards such as scores, achievements, and game items) and social rewards such as peer attention that may foster a preoccupation or an intense interest in the game. In addition, role-playing games have the potential to be more time consuming than other games because players must create and maintain characters over time and have the option to explore open-ended virtual worlds, possibly increasing the likelihood of problematic use patterns. These role-playing games appear to be more closely associated with addiction.

Mazurek & Engelhardt (2013) also found a relationship between the amount of video game play for children with ASD or ADHD and inattention. This correlation does not indicate that video game play for children with ASD or ADHD causes inattention but that the more inattention a child displays the more likely he is to play video games for extended periods of time. They also found that boys with ASD or ADHD may have greater in-bedroom access to video games than typically-developing children. The authors hypothesized that children with ASD or ADHD are more preoccupied with games, resulting in their asking for more access to video game consoles or computers in their rooms, possibly leading to more problematic use. They also suggest the possibility that the parents of children with ASD or ADHD may offer increased access to these media "as a means for managing difficult behavior."

Best Practices

The potential for using video games and other digital media to improve social, problem-solving, and executive-functioning skills in children with ADHD and ASD is just being explored. The use of apps and games to help develop these skills in the classroom offers teachers an opportunity to engage these children in a way that traditional education cannot readily accomplish. These technologies improve the level of attention, effort, and motivation to learn. They also enhance communication among students, provide opportunities for differentiated instructional models, and may lead to practice and mastery of these behaviors outside of the classroom.

Games designed specifically to teach a population of children affected by ADHD or ASD can be very powerful. Alternatively, using popular games that children already enjoy and play can practice many of the problem-solving and executive-functioning skills that are areas of weakness in children with ADHD and ASD.

Ensuring generalization of skills from games to the real world remains the key for successful use of these technologies with children with ADHD and ASD. The current chapter explored two different methods that include generalization strategies on the part of classroom teachers to take the skills that children practice in games and use them more effectively in real-world settings. This type of instructional program will remain the best model until these types of generalization strategies are embedded directly into games and apps. By incorporating generalization tools into popular games, publishers can make many fun, engaging games into teaching tools for children with ADHD and ASD.

Resources

Books

Davidson, Cathy. *Now You See It*

Kulman, Randy. *Playing Smarter in a Digital World. A Guide to Choosing and Using Popular Video Games and Apps to Improve Executive Functioning in Children and Teens.*

Kulman, Randy. *Train your Brain for Success. A Teenagers Guide to Executive Functions*

Barkley, Russell. *Executive Functions: What They Are, How They Work, and Why They Evolved*

Goldstein, Sam., *Naglieri, Jack. & Ozonoff, Sally. Assessment of Autism Spectrum Disorders*

Websites

LearningWorks for Kids (learningworksforkids.com)
Edutopia (http://www.edutopia.org/)
Children and Adults with Attention-Deficit/Hyperactivity disorder (http://www.chadd.org/
Autism speaks: (https://www.autismspeaks.org/)
South County Child and Family Consultants (southcountychildandfamily.com)
Understood for Learning and Attention Issues (understood.org)
TeachTown. Educational Products for Children with Autism (teachtown.com)
Bridging the gap between technology and people with disabilities (http://bridgingapps.org/)

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