# Technology Tools for Students with Autism

## Innovations that Enhance Independence and Learning

edited by

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**Katharina I. Boser, Ph.D.,** received her B.A., M.A., and Ph.D. from Cornell University in developmental psychology and cognitive science and wrote her dissertation about the early development of child language. She completed postdoctoral work at the University of Maryland studying language rehabilitation using computing technologies for patients with aphasia. In 2000, she joined the research faculty at Johns Hopkins University School of Medicine in Cognitive Neurology, where until 2005 she studied language training with low-verbal subjects and cognition (number representation, memory, and visual attention) in children with autism. She has conducted research on social robots and is involved in usability research with technology companies developing computer software for use with children with autism and other cognitive and/or learning issues. She was a board member and later cochair of the Innovative Technologies for Autism initiative for Autism Speaks until 2011. Dr. Boser is president of Individual Differences in Learning, an educational nonprofit in Maryland that provides professional development to teachers and parents regarding brain-based teaching techniques and innovative technologies for students with a range of cognitive impairments, including autism and twice exceptionality. She presents at many national and international conferences on autism technology research and cognition and advocates for universal design for learning and 21st-century learning and teaching at state and national levels. Since the fall of 2011, she has been a technology coordinator for the Glenelg Country School in Ellicott City, Maryland.

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**Sarah C. Wayland, Ph.D.,** is a senior research scientist at the University of Maryland's Center for Advanced Study of Language and a faculty affiliate in the Special Education Program in the College of Education. She has worked on issues pertaining to language for over 25 years, first at Brandeis University, where she earned a Ph.D. in Cognitive Psychology, and then at Northeastern University, the University of Maryland School of Medicine, and now at the University of Maryland College Park. She was not in academia for all that time; for over a decade she worked in industry designing those annoying telephone voice systems everyone loves to yell at.

Active in the local disability community, she has helped organize numerous conferences designed to help parents and professionals learn more about ways to help their children with disabilities. She is on the executive committee of the Individual Differences in Learning Association and has been a board member of the Special Education Citizens' Advisory Committee of Prince George's County, Maryland, since 2007. She comoderates GT-Special, an international Listserv for parents of twice-exceptional children (children who are both gifted and learning disabled), and is a member of the Gifted and Talented with Learning Disabilities (GT/LD) Network. She is also a Parents' Place of Maryland PEP (Parents Encouraging Parents) leader of Prince George's County, Maryland.

Dr. Wayland lives with her wonderful husband and their two fabulous boys in Riverdale Park, Maryland.

CHAPTER

# 3

# Classroom-Based Technology Tools

Christopher R. Bugaj, Melissa A. Hartman, and Mark E. Nichols

A vast array of low- to high-tech tools may be utilized to reduce and even eliminate educational barriers for students with autism spectrum disorders (ASDs). This chapter describes a sampling of the tools available to support students in accessing the general education curriculum to the greatest extent possible. Examples of how the tools may be utilized with students and integrated into the curriculum are provided via vignettes. It is important to note that the tools and strategies presented in this chapter must be adapted to meet the needs of the individual student. Technology tools should never be globally grouped and categorized around a specific disability. A tool that may appropriately support one student to varying degrees may not adequately support another student with the same disability. Any tools selected for use should be based on student need, the environment(s) for which the tools are required, and the educational tasks for which the student requires support (Zabala, 2005).

## TOOLS FOR ROUTINES AND SELF-MANAGEMENT

Routines are integral parts of daily life for students with ASDs and foster successful engagement and increased independence by helping a student manage the social and academic pressures associated with various school environments. Disruptions to normal routines can often trigger confusion and adverse behaviors. It is imperative that teachers of students with ASDs reinforce appropriate routines and transitions to prevent students from developing their own systems, which may not be as adaptive or effective as those developed by the teacher (Mesibov, Shea, & Schopler, 2005). A clearly defined and structured environment is vital in creating positive outcomes.

Technology tools can readily support a student in reaching full academic potential. Sometimes, the least restrictive solutions for engaging students within the curriculum involve common tools found within the home, school, or work environment. For instance, Microsoft Word and Microsoft PowerPoint, two powerful tools that are common in many classrooms, have a variety of premade templates that can quickly be accessed to create learning resources. Both Word and PowerPoint can be used and modified in conjunction with clip art to create personal visual schedules, behavior charts, or even contextual stories depicting appropriate student social interaction. Visual schedules provide clear direction while requiring minimal social exchange by the educator, thus eliminating potential confusion by the student.

The research of Bryan and Gast (2000) supports the benefits of utilizing visual schedules with students with ASDs. Students were able to learn how to follow the schedule and were able to generalize the schedule to different settings successfully. When the visual schedules were removed, productivity and ability to transition decreased. An individualized visual schedule may be prominently posted on the wall, on the student's desk, or in a folder or notebook. The most common visual schedules list activities by times. For example, the day may be divided into 30-minute increments with pictures and/or phrases that can be moved from area to area depending upon the day and the activities. For durability, schedules should be laminated with information that is fixed. Velcro dots may be attached to pictures and/or phrases and affixed to the chart at the appropriate times (Figure 3.1).

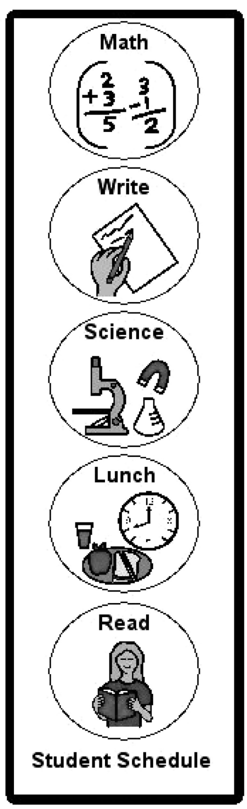


**Figure 3.1.** Linear student schedule. Linear schedules help organize sequentially occurring activities or tasks for a student. This schedule depicts five specific periods throughout the student's day (math, write, science, lunch, read). (The Picture Communication Symbols ©1981–2010 by Mayer-Johnson LLC. All Rights Reserved Worldwide. Used with permission. Boardmaker™ is a trademark of Mayer-Johnson LLC.)

Behavior charts help facilitate independent self-monitoring and discrimination between appropriate and inappropriate behavior. These charts may be self-sustained by the student or managed by an educator. As with visual schedules, the behavior chart should be easily accessible to the student. Affixing the chart or schedule in a consistent location across environments is beneficial to promote self-management. These resources may be printed, laminated, and affixed to the student's desk, placed within the student's personal agenda book, displayed on the classroom wall, or manipulated virtually on an electronic device.

A variety of self-directing supports should be accessible throughout the school day. These may include, but are not limited to, a specific cool-down area or space with sensory materials (e.g., lotions, stress balls, items of specific interest to the student). Colored tape can be used to create a defined personal space on the floor in front of a whiteboard or particular workstation as a visual cue for students to remain seated within the square to help elicit engagement during group activities (Figure 3.2). The targeted skill (of staying seated during group activities) can be reinforced by the tape and visuals attached to the tape on the floor. Alternatively, the teacher can present various visual choices to allow for greater self-direction and independence.

We live in an era where an ever-increasing number of students arrive at school with portable computers in their pockets and backpacks. These handheld mobile devices have revolutionized the way students can access web-based resources,

**Figure 3.2.** Desktop workspace marker. Desktop workspaces can be isolated by using masking tape.

manage lifestyles, communicate with others, and be entertained through a vast array of multimedia. These tools provide on-demand access and supports for maintaining continuity in student learning across all environments. For students with ASDs, these tools may assist in self-managing behavior, monitoring routines and schedules, and ultimately increasing independence. For example, the device could have a preloaded digital story that visually reminds the student how to handle stressful situations when feelings of anger or frustration are predominant. One student may use mobile electronics to quickly pull up a feelings chart with appropriate coping strategies to foster an environment of self-recognition of feelings, whereas another student may use the tool to watch a short video modeling successful self-management techniques when engaged in a particular task or activity. Alternatively, when an environment becomes overly stimulating due to loud noises or disruptions, students may find comfort in using headphones and listening to music in order to focus on the task at hand. Students may utilize mobile technology in varying degrees to help support achievement across the environments in which they interact.

### TRANSITION TO SCHOOL

When Mike steps on the bus, he sees the driver pointing to a picture. The picture is one of many that are strung around the driver's neck on a lanyard (Figure 3.3). His finger taps the symbol of a boy sitting on a seat. Mike looks at the driver and says "hello" just as it says to do in his social situation story. The bus driver replies, "Good morning, Michael," and Mike takes his seat. Mike gets out his handheld device and turns it on. He navigates to his personalized story on the device and by swiping his finger, reviews his story. Each page has a picture of Mike engaging in tasks throughout the day. The first picture shows Mike eating breakfast, the second brushing his teeth, the third getting dressed, and the fourth Mike getting on the bus. The next picture depicts Mike arriving at school. Mike has earphones so he can listen to his "morning routine" social situation story but typically chooses to watch the story and read the short text that appears beneath. Sometimes, the constant roar from the bus engine distracts Mike. When this happens, Mike's independent self-management technique involves listening to soft music through his headphones to help him stay focused on the next aspect of his morning routine, arriving at school.

## TOOLS FOR STRUCTURING THE CLASSROOM ENVIRONMENT

Students with ASDs require a structured day and a predictable, calm environment in which to navigate the school day effectively (Cumine, Leach, & Stevenson, 1998). Classrooms that serve students with ASDs should be flexible and contain academic, sensory, and group and individual spaces (Vogel, 2008). Students should have their own workstations or offices that are relatively free from distractions, complete with specified areas for necessary materials and visual schedules (Figure 3.4). Teachers may use dividers (portable walls) or bookshelves to provide a specific area for each student. This area may contain bins of activities, both preferred and academic, as well as any materials necessary to complete work. The workspace should be arranged in a natural progression with work to be completed in a folder or bin on the left side of the desk and completed work on the right. Some teachers utilize plastic bins for this purpose; others attach folders to each side of the desk. The materials used will depend upon the individual needs of the student.


**Figure 3.3.** Communication lanyard. Communication lanyards are a great way to quickly relay or elicit communication regardless of environmental conditions. (The Picture Communication Symbols ©1981–2010 by Mayer-Johnson LLC. All Rights Reserved Worldwide. Used with permission. Boardmaker™ is a trademark of Mayer-Johnson LLC.)

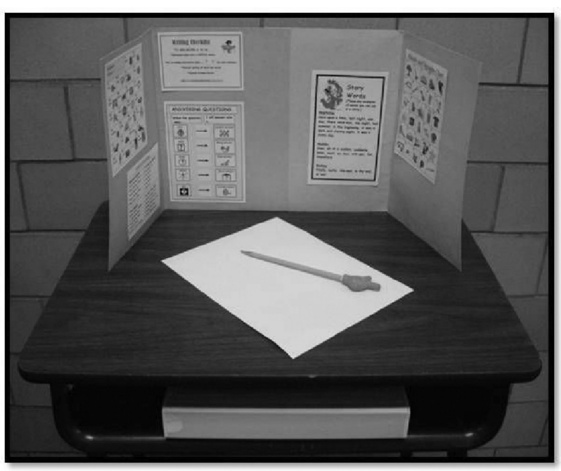

**Figure 3.4.** Student study carrel. Study carrels are a great low-tech method for creating a customized learning support to reinforce concepts and to meet the needs of each individual student.

In her article "Design for Living and Learning with Autism," Vogel (2008) outlines that classrooms should be safe, predictable, nondistracting, controllable, attuned to students' sensory needs, noninstitutional, flexible, and adaptable. The article provides excellent detail and examples for classroom use that are beyond the scope of this chapter.

Sensory breaks should be listed on the schedule as well as lunch and all other activities the student participates in throughout the day. Utilizing Velcro to post the activities allows teachers or students to change the order and activities as necessary throughout the year. Students can remove the activities upon completion and place them in a "finished" sleeve or container (Figure 3.5). Such software programs as Boardmaker Plus may be used to create the pictures for the schedules. Some students may be more responsive to using digital photos of themselves or others completing tasks, whereas others may just need words or short phrases. Text can be paired with the visuals to reinforce language development and reading skills. Visual schedules should vary depending upon student needs. At the secondary level, students may have a sheet in a notebook containing a simple list of tasks in phrases that can be checked off as the tasks are completed. The key is to have a complete schedule for each day so the student knows exactly what to expect.

The sensory area should contain items collaboratively reviewed by the teacher and any related service providers, such as physical and occupational therapists. Sensory areas may contain a wide variety of apparati and tools, among them swings, mini trampolines, stress balls, exercise balls, weighted vests or lap bands, tents, beanbag chairs, and pillows with differing textures. Students may utilize this area for a "chill out" space where they sit and read or listen to music or take specifically recommended sensory breaks. It is essential that a physical therapist ensure that all classroom staff know how to assist students in utilizing each apparatus correctly and within recommended time limits. Teachers can use visual timers, clocks or timers on the interactive whiteboard, or other digital devices to assist students in moving from one activity to the other.

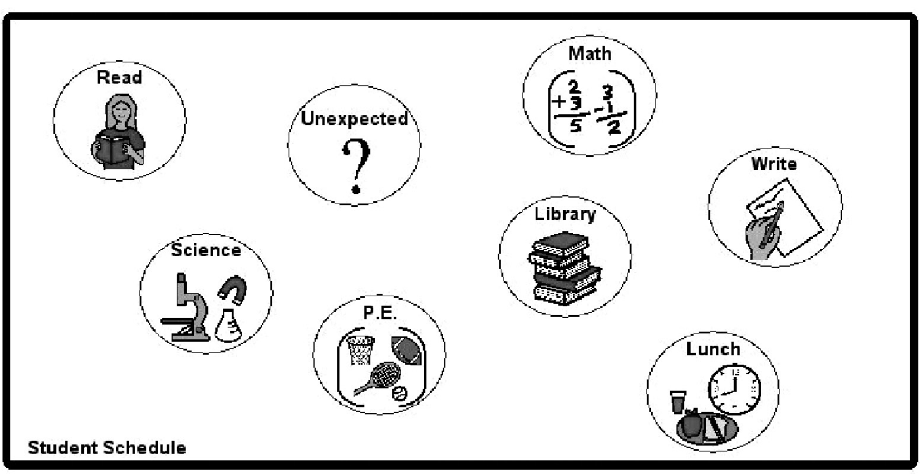


**Figure 3.5.** Nonlinear student schedule. Nonlinear student schedules allow students to select and choose one of the desired activities in a preferred order. (The Picture Communication Symbols ©1981–2010 by Mayer-Johnson LLC. All Rights Reserved Worldwide. Used with permission. Boardmaker™ is a trademark of Mayer-Johnson LLC.)

## TOOLS FOR DELIVERING INSTRUCTION

According to the principles of universal design for learning, it is imperative that teachers utilize multiple means for representation when delivering instruction to reach all students regardless of ability (Rose, Meyer, & Hitchcock, 2005). Each student has preferred styles of learning as well as specific strengths and weaknesses when receiving and presenting information. Students with ASDs tend to be visually oriented, thus using interactive whiteboards to present information via video and interactive games and activities is extremely engaging. Interactive whiteboards allow students to participate in tactile and kinesthetic activities. They also provide a way for teachers and students to present videos, including multimedia slideshows such as PowerPoint presentations and Prezis, and digital books to share with the class or individual students. Digital simulations are also very popular. Virtual dissections, math manipulative activities, space exploration, archeological digs, and additional activities are all available on the internet. A simple keyword search will yield more results than teachers can possibly use. Teachers may also utilize cell phones and other handheld devices to present information to students via messaging, podcasts, notepads, voice recordings, and the like (Kolb, 2008).

To eliminate barriers inherent in traditional textbooks and on web sites, text-to-speech software may be utilized on the computer to read web pages, text, and trade books. Such software programs as Read&Write Gold provide students with a variety of accessibility tools, including speech-to-text as well as such editing tools as a spell checker, word predictor, dictionary, word wizard thesaurus, and a sounds alike tool that helps users determine if they have chosen the correct homophones in their writing. In addition, Read&Write Gold provides the following features:

- MP3 converter to convert text into files for later playback on an MP3 player
- Pronunciation tutor, fact-finding tool, and fact-mapping graphic organizer tool
- Voice dictation tool for writing assistance
- Floating toolbar that allows users to access Read&Write Gold from within word-processing or portable document format reader programs (see http://www.bit.ly/aboutrwg)

Free applications that provide similar supports can be found online (e.g., http://www.eduapps.org and http://www.portableapps.com). These applications may be loaded onto a USB drive and easily transported for use on any computer without internet access.

Such interactive digital tablets as the iPad are a portable mode of presenting information to students. Thousands of applications are available on these devices for presenting material in all content areas. These devices can be used as calculators, compasses, art canvasses, and more. If you can think of it, there is likely an app for that purpose. It is important to remember when using these devices that many applications have a price tag, and even those that appear to be free may give you a sample of the program but require you to purchase other parts.

Low-tech and no-tech options for presenting material include paper maps, photographs, drawings, graphic organizers, dry erase boards, and books. Regardless of which tools you choose to use, it is important to choose with a specific purpose in mind and to choose the tool that appropriately matches the purpose as well as students' needs.

### SCIENCE CLASS

Sarah enters the group area of the classroom for the science lesson. The teacher has the goal for the day posted on the interactive whiteboard: to identify three types of volcanic cones. The teacher shows video clips of three different active volcanoes and then asks students to identify the similarities and differences. When it is Sarah's turn to go to the board, she uses the pen to write *smoke* in the similarities column on the whiteboard. The teacher then pulls up a web page with pictures of the different volcanic cones along with their names. For the next activity, Sarah is asked to come up to the board and drag the correct name to the volcanic cone it matches.

## TOOLS FOR EXPRESSION OF KNOWLEDGE AND PRODUCTIVITY

It is important to recognize that an attribute of the human condition is the need to communicate with others. Successful communication happens in a variety of ways using multiple modalities (Pearce, 1989). Individuals communicate through words, gestures, writing, artistic expression, and more. These means can be organic (speech or gestures) or mechanical (technology) in both analog and digital formats.

The tools 21st century students with ASD have to express themselves are vast and varied. It would be impossible to try to capture every tool students have available to them that could be used to demonstrate their knowledge; however, this infinite array of options can be clustered into categories to help organize the technology into manageable components. In this way, educators can focus on the task to be accomplished and subsequently look at the tool or tools that could be used to facilitate that task.

## TOOLS FOR VERBAL EXPRESSION

Difficulties with verbal expression present themselves in a multitude of complex ways, including concerns with the form, structure, and meaning of language, along with the accurate physical production of sounds in connected speech. The tools used to help students communicate can be grouped in two primary categories: augmentative and alternative. Augmentative systems are tools that help people whose primary form of communication is through verbal speech but who demonstrate difficulty with successful communication interactions. This difficulty might include problems with prosody, intelligibility, vocal quality, or language processing or with some other barrier to successful verbal exchanges. Augmentative tools work to facilitate communication by enhancing or supplementing verbal speech. When an individual does not demonstrate the ability to produce verbal speech, an alternative approach to verbal communication is necessary. It is common to refer to both augmentative and alternative communication together using the acronym AAC.

Among other strategies to facilitate communication, AAC technologies, like any other set of tools, span a range from no-tech to very dynamic, intricate digital systems. A pacing board is a set of displayed shapes to help provide and represent a visual, kinesthetic, and tactile model particularly useful for helping students expand their length of utterance and/or change their rate of speech. For instance, when a student makes a one-word verbal request, such as "toy" to indicate he or she wants a particular toy, a communication partner might draw three circles on a piece of paper, point to each circle and say, "I want toy," and then present the circles to the student with the expectation that the student would use the circles as a model for verbal reproduction.

Similar to a pacing board, a sentence starter strip provides a student with a visual representation of what to say in the form of a set of picture symbols followed by an empty cell. Like the cloze procedure for assessments, the expectation of the student is to complete the utterance by verbally filling in the blank. Common sentence starters include "I want...," "I see...," "I am...," and "Where is..." although other phrases are also often used.

Either by pointing or through the exchange of pictures, students could maintain a library of picture symbols to facilitate communication called communication notebooks. These communication systems can be maintained on a single board or within a notebook organized by function. Students locate a picture symbol or sequence of symbols to indicate messages. Velcro is often used to fix the picture symbols in place when making exchanges (Figure 3.6).

Voice output devices generate either a recorded or synthesized message when a cell (like a button) or set of cells is activated. Static voice output devices have a set number of cells that typically cannot be changed. Some devices have levels that allow for a user to access a greater number of messages using the same set of defined cells. For instance, a user might have an array of eight cells each with a different word or phrase set to the first level. Changing the device to Level 2 would allow the student to access an entirely new set of preprogrammed words or phrases.

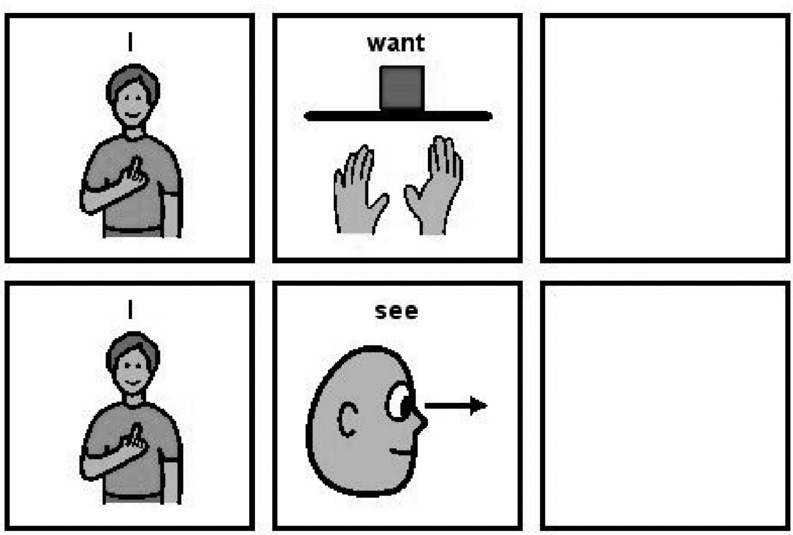


**Figure 3.6.** Carrier phrases. Communication strips with carrier phrases (created using Mayer-Johnson symbols) can be used to prompt student communication. (The Picture Communication Symbols ©1981–2010 by Mayer-Johnson LLC. All Rights Reserved Worldwide. Used with permission. Boardmaker™ is a trademark of Mayer-Johnson LLC.)