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How Robots Can Assist Students With Disabilities

New tools use artificial intelligence to assist students with autism and dyslexia and address accessibility for those who are blind or deaf.

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This article is part of a limited series on how artificial intelligence has the potential to solve everyday problems.

Imagine: Robots that help teach social skills to children with autism. Translation software that provides deaf students with a more fluid and interactive experience. Data analysis to determine effective methods to identify those with dyslexia.

These tools, which all incorporate artificial intelligence, aim to find better ways to detect, teach and assist those with learning disabilities. Some are already in classrooms; others are still in the research phase.

Social robots, which are made to interact with humans, can help teach social and educational skills to students of all abilities, including those with attention deficit hyperactivity disorder, hearing impairments, Down syndrome and autism.

Addressing the needs of children on the autism spectrum is particularly urgent because of their sheer numbers — one in 54 children are diagnosed with autism, according to the Centers for Disease Control and Prevention.

And those students tend to respond to robots "in a way that they don't to puppets or pet therapies, or to many of the other kinds of things that we've tried," said Brian Scassellati, a professor of computer science, cognitive science and mechanical engineering at Yale University.

That may be because robots seem humanlike but are nonjudgmental, he said. The robots come in a variety of designs, including a small boy, a classic sci-fi machine and a furry snowman, and they go by peppy names such as Kaspar, Nao and Zeno.

In a recent study by Professor Scassellati and his colleagues, an early prototype of a robot named Jibo — which looks like a small table lamp with a round head that swivels in all directions and a glowing white circle on a touch screen as its face — worked every day for 30 days with 12 children and their caregivers. Jibo modeled social-gaze behavior, such as making eye contact and sharing attention, and provided feedback and guidance during six interactive games played on screens.

"The robot's job was to adjust the difficulty of the game based on the child's performance," Professor Scassellati said. But the idea isn't that the robot replaces a teacher or caregiver. "We never want to encourage kids to just respond to the technology — that doesn't do them any good," he said. "We want to enable them to interact with people in a more substantial way."

Research has found that the robots help improve educational and social skills, but far more studies are needed to discover how to make these changes stick and translate to the real world.

How does A.I. play into this? Technology has advanced, but so has research into how perceptions are formed, how people can infer each other's feelings and thoughts and what constitutes emotional intelligence. These insights can be translated into algorithms that allow robots to interpret speech, gestures and complex verbal and nonverbal cues as well as learn from feedback.

Danielle Kovach, who teaches third-grade special education in Hopatcong, N.J., said she would be curious to see what further research shows. "So much of teaching social skills to students with autism is reading facial expressions, reading body languages and picking up on social cues of others. Is a robot able to mimic those things we learn from humans?" she said. Dr. Kovach is also the president of the Council for Exceptional Children, an organization of special-education professionals.

While the social robots are primarily used in research studies, there is a nascent marketplace aimed at classrooms and individuals. For example, LuxAI, a Luxembourg-based company, has been selling the friendly-looking QTRobot, designed for children with autism, to parents since early 2021; right now it operates only in English and French.

Children with autism interact with the robot daily for 10 minutes to an hour, depending on their age and level of support needed, Aida Nazari, a co-founder of LuxAI, said. The company has sold a few hundred QTRobots, primarily to families in the United States, she added. But many families may find that a social robot is far too expensive at this point: QTRobot costs $2,000 plus a $129 monthly software subscription, which includes support services.

Rachel Ricci was the first person in Canada to order a QTRobot, receiving it in February 2021. Her son, Caden, 10, was diagnosed with autism when he was 3 years old. Caden and his parents or therapist use tablets to play games aimed at enhancing his educational social skills, such as recognizing and naming emotions. QTRobot serves as an encouraging third friend and teacher.

He uses it for 30 minutes five days a week, and "QT helps him build his confidence," Ms. Ricci said. Getting the robot during the pandemic was a lifesaver, she added: While most of his classmates at a Montreal school for those with autism regressed when school closed and therapists were unavailable, Caden stayed on track. Ms. Ricci credits QTRobot with that.

But others say there's a big difference between one-on-one use of a robot in a private home and use in a school setting.

While such technology can be "seductive," it is "rarely used completely as intended in the classroom," said Jordan Adcock, who teaches fifth grade in Forest Grove, Ore., and has a son with autism. "What we really need are more teachers, aides and a high-quality curriculum."

A.I. is also used in a simpler way to help those living with autism: through gaming. Maithilee Kunda, an assistant professor of computer science at Vanderbilt University, and her colleagues created a video game called "Film Detective," which will be piloted this spring.

The concept: The player wakes up in the future — the year 3021 — and has to help a scientist and her robot sidekick catch a villain who is stealing items from the Museum of Human History. Their detective work involves using a series of film clips to decode how people in today's world behave.

"Many with autism have superior visual thinking but have a lot of difficulty with social action," Professor Kunda said. "So, we thought, what if we can give them visual ways to imagine theory of mind?" Theory of mind is the ability to imagine what other people are thinking or feeling — something those with autism can find particularly difficult, which may make social interactions challenging.

The game taps into theory of mind by using movie clips, asking players to interpret why characters acted the way they did and what they might have been thinking.

Without A.I., "it would have been possible to make the game and watch the movies together, but the unique thing we're providing is a very detailed and explicit theory of how social reasoning works that can be simulated. We can use it as scaffolding to help teach kids," said Professor Kunda, who also directs Vanderbilt's Laboratory for Artificial Intelligence and Visual Analogical Systems and is a researcher at Vanderbilt's Frist Center for Autism and Innovation.

The use of A.I. to improve visual and auditory accessibility is also evolving quickly.

For example, the National Technical Institute for the Deaf, one of the nine colleges of the Rochester Institute of Technology, worked with Microsoft to customize technology and platforms that already existed in order to caption classes for deaf and hard-of-hearing students. The classes have sign-language translators and stenographers, but more assistance was needed.

For the institute's purposes, Microsoft Translator was "taught" specialized terminology used in classes as well as vocabulary specific to the university, such as the names of certain buildings and people, said Wendy Dannels, a member of the research faculty who is deaf.

With A.I., the speech-to-written-word translation is far more fluent than automatic speech recognition used to be, she said. And spurred by the pandemic, during which face coverings made communication particularly difficult for many deaf and hard-of-hearing people, the institute developed an app called TigerChat. The app turns speech into text messages, making it easier to chat with friends.

In addition, faculty members at the institute are working with Vuzix, a company that has developed eyeglasses that can display text directly on the lenses. Roshan Mathew, a graduate student in computer-human interaction at the Rochester Institute of Technology, has tried the Vuzix glasses and loves them. "When I have to use a smartphone or laptop when talking to someone, I can't maintain face-to-face contact," Mr. Mathew, who is deaf, said. "Communications are not just what we say, but what we see."

A key use of A.I. in special education is its ability to detect patterns in large amounts of data to better identify and define certain disabilities.

Take dyslexia, for example. Those with the condition typically have reading difficulties because they have trouble connecting the letters and words on the page to the corresponding sounds they represent. As of 2020, 47 states required that students be screened for dyslexia in early elementary education. Yet there is no tool designed specifically for this, and dyslexia is often misdiagnosed — or missed completely.

The most widely used assessment for dyslexia is a test called DIBELS (Dynamic Indicators of Basic Early Literacy Skills), typically given to all students in kindergarten through third grade to assess their overall reading and literacy, said Patrick Kennedy, a senior research associate at the University of Oregon's Center on Teaching & Learning. The test was not designed to detect dyslexia but is used "in the dearth of other tools," Dr. Kennedy said.

Dr. Kennedy and his colleagues plan to recruit 48 elementary schools in the United States and have 4,800 students in kindergarten through third grade take the DIBELS assessment.

Over the next three years, they will examine the outcomes — using machine learning — to determine patterns in the development of reading and spelling over time. Ultimately, the researchers hope to evaluate if DIBELS successfully identifies dyslexia and how it can be used most effectively.

“The purpose of this project is to provide schools with better information to allow them to make better decisions,” Dr. Kennedy said.

A version of this article appears in print on , Section B, Page 4 of the New York edition with the headline: For Children With Autism, Robots Can Be Friendly Teachers