

Thierry Karsenti  
University of Montreal  
Canada



Julien Bugmann  
University of Montreal  
Canada



Pierre-Paul Gros  
University of Montreal  
Canada



# Using Humanoid Robots to Support Students with Autism Spectrum Disorder

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### Rencontrez Nao!



In recent years, an increasing number of robots have found their way into American, Asian, and European classrooms. With names like Bee-Bot, Dash, Mindstorm, and Sphero, they offer exciting educational potential and have attracted growing attention from the education community. Recent studies have shown that these robots can serve as powerful educational tools, especially for students with learning disabilities. A robot subgroup, the anthropomorphic robot, appears poised to become the gold standard for educational use. The anticipated contributions of the anthropomorphic robot to development and learning provided the motivation for an exploratory research project. This paper focuses on the application of a robot called NAO to support children with autism spectrum disorders (ASD).

### Anthropomorphic Robots in Education

Anthropomorphic robots resemble humans, physically: they have a head, a torso, two arms, and two legs. Some even have a face that (somewhat) resembles that of a child, with eyes, a mouth, and a silicone or plastic skin-like coating. These innovative technological tools are spreading through modern schools, and appear poised to be major players in future education systems. However, few Québec students have met one of these futuristic androids. Accordingly, we conducted a research project to examine two impacts of the use of an anthropomorphic robot called NAO to support students with learning disabilities. First, we looked at the impact on learning how to code, and second, we looked at the impact on social and academic development in ASD students as perceived by their educators. This paper focuses on the second impact.

## Who is NAO, the Anthropomorphic Social Robot?

Standing 58 centimetres (23 inches) tall and weighing 4.8 kilograms (32.6 pounds), the anthropomorphic social robot NAO talks by itself, responds to questions, and even seems to recognize some emotions. With its built-in cameras, detectors, and microphones, it can hear, recognize, and interact with humans. It is therefore no surprise that many researchers are curious about how children interact with these robots. Indeed, previous studies have demonstrated that preschool-aged children readily interact with these types of robots and are fascinated with the way they move.

## Can Robots Help ASD Students?

For the betterment of our future society, we need to think today about what our schools will look like tomorrow. The situation will become even more critical for children who struggle in school, including those with learning disabilities such as ASD. The needs of these children should be prioritized to ensure that they grow up to be autonomous, independent, and above all, successful citizens. Anthropomorphic robots such as NAO as well as targeted curricula are sometimes used to help students with ASD to interact with others and develop social skills. By providing opportunities to interact, NAO has demonstrated positive outcomes for ASD students. NAO has been the subject of many studies, notably in terms of its appraisal as a pedagogical aid by preschool and elementary school teachers. The results indicate that teachers are generally highly appreciative of the robot as a pedagogical tool, and that students find using it highly enjoyable. These findings are of particular interest in the case of ASD students. These students generally find it hard to interact with others, prefer to participate in repetitive games, have communication problems, and show little interest in others. NAO could replace the teacher at times in order to help these children develop certain skills. For example, NAO could help ASD children develop a better sense of touch and awareness of their own body. This could make a significant contribution to autism therapies, particularly in terms of cognitive development. Hence, NAO could positively influence the development of cognitive, physical, conceptual, social, and linguistic competencies in this population, and this potential provided the main motivation for this exploratory study.

## Procedure

Integrating the NAO robot into an ASD classroom helps address a major societal issue. Some might ask, why study this group of children? The main reason is that, more than any other, this particular population requires substantial scaffolding to enable them to integrate into today's and tomorrow's society. In addition, and perhaps more importantly, the presence of NAO in the classroom could alleviate the communication difficulties that afflict these children. Furthermore, these children, who struggle to thrive in mainstream classrooms and require differentiated educational resources, have a more urgent need to become digitally and technologically literate than their peers. We therefore investigated the use of anthropomorphic robots such as NAO as potential support tools for ASD students.

This exploratory study was conducted in a class of elementary school students with ASD. Using individual and group interviews as well as filmed observations, we examined the impact of the anthropomorphic robot on the students.

Meetings were set up between ASD students and NAO. The protocol design was based on an extensive review of the literature on the educational use of robots, with the additional input of frequent meetings and discussions with the school board members and educators involved in the project. The meetings were designed to include progressive stages of verbal and physical interactions between the children and the robot, while keeping in mind the learning and development of specific motor and intellectual competencies. With the support of teachers and educators, the students were asked, for example, to imitate the robot's movements, ask the robot questions and answer the robot's questions, play with the robot, read a book to the robot, and establish a correspondence with the robot (when it was not in class).

## **The Many Positive Educational Outcomes for Students**

This exploratory study allowed the identification of several positive outcomes of the educational use of robots with ASD students, as follows:

- Increased motivation and investment in academic tasks and in school overall, as noted by the teachers and as observed in all participating students.
- Longer attention span: students remained focused throughout the activities, remained calm, and applied themselves in their interactions with the robot. This finding is significant, as students with ASD often have difficulty focusing on schoolwork. The robot helped them focus on immediate tasks.
- Improved listening to and understanding of instructions, especially when the robot asked students to accomplish specific tasks. When the robot asked the students to complete a task, they listened intently and understood what the robot was asking. A single prompt was enough for the students to complete the required task.
- Improved language skills: during the meetings between robots and students, numerous verbal exchanges took place. Students were constantly asking the robot questions, and even insisted on telling it jokes.
- Improved socialization: interactions between the children and the robot as well as their mutual correspondence demonstrated a significant impact on social skills. Students interacted more with each other and with other people in the room, especially when discussing the robot.
- Improved reading skills: following NAO's visit to the classroom, the students received personalized letters with a picture of NAO to strengthen the mutual bond and to encourage the students to write. This was considered a success, as all the students, with the help of their teacher, corresponded with NAO via traditional mail. In the exchanges, the students asked the robot questions and the robot gave the students reading "assignments" so that they could discuss the readings at the next face-to-face session.

- Improved writing skills: as mentioned above, a successful written correspondence was established between the students and the robot. This not only enabled the students to practice their writing skills, it also gave them an opportunity to ask NAO creative questions. For example, they asked it if it had a romantic partner or if it could clean the students' room.
- Improved body control: through activities that involved imitating the robot, identifying body parts, and coordinating movements with the robot. NAO would ask the students to mimic its movements or to touch certain of their body parts, tasks at which they succeeded.

Despite all these significant positive outcomes, it should be noted that initial contacts between the students and the robot were not always successful. Nevertheless, many students who were wary of NAO at first ended up being among its proudest champions, and they demonstrated their affection by taking pictures with the robot and posting them online.

## Conclusion

In addition to substantially boosting motivation, the interactions between an anthropomorphic social robot (NAO) and students with autism spectrum disorder (ASD) produced a variety of positive and significant pedagogical outcomes. The students demonstrated growth in several core competencies that are important for social and academic success, including socialization, reading, and writing. Although these preliminary results are promising, further studies are needed to explore the full potential of this type of robot.

## Pour citer cet article

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