NAO Robots Help Children with Autism Develop Social Communication Skills

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Introduction

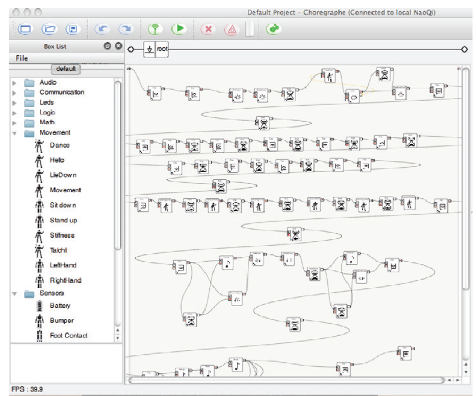
In the United States, federal law mandates that all children, including those with autism spectrum disorder (ASD), have the right to an education within the least restrictive environment (Individuals with Disabilities Education Act Improvement Act [IDEA], 2004). The development of social skills is often a challenge for children with ASD, which becomes a significant barrier to inclusion (APA, 2022). While IDEA (2004) provides physical access to general education, research suggests that placement alone does not ensure social integration. Despite being included in general classrooms, children with ASD often experience social isolation because they lack the specific communication skills needed to move from the sidelines into meaningful peer relationships (O'Keeffe & McNally, 2023). Khoirunnisa et al. (2025) further supported this idea, reporting that children with ASD experience greater success in inclusion settings when they have developed social communication skills. O'Keeffe and McNally (2023) noted that social communication challenges not only affect engagement with peers but also group work and academic discussions, including the ability to make requests and follow verbal instructions.

To promote meaningful inclusion for children with ASD, instructional strategies are implemented to reduce the barriers resulting from social communication skills that these children face (Dyer, 2022). These strategies often rely on explicit, direct instruction to establish joint attention and imitation (Alnafjan et al., 2025; Sani-Bozkurt & Bozkus-Genc, 2023). Such approaches align with Vygotsky's (1978) sociocultural theory, which proposes that higher mental processes appear first on a social level through interaction before they are internalized by the individual. Xiao and Li (2025) found significant positive correlations between imitation and social communication skills, with vocal, gestural, and object-related imitations linked to expressive communication, joint attention, and social skills. They also maintained that imitation is part of the foundation of social learning (Xiao & Li, 2025), serving as a form of cultural mediation in which tools and signs facilitate development. However, frequent encouragement of imitation—such as a parent prompting a child to repeat "mama"—often remains rote rather than functional. The skill fails to be internalized in the child's Zone of Proximal Development, and does not transition to an independent, spontaneous social communication. Children with ASD often face challenges in this area, which impede the development of broader social communication abilities (Hadders-Algra, 2021). The purpose of this reflective article is to examine how the NAO (pronounced now) robot can support social communication and inclusion for children with ASD in elementary settings.

NAO Humanoid Robots

The significance of imitation in social communication development prompts the use of the NAO robot made by SoftBank Robotics (2026) as an instructional strategy that relies on technology to build social communication skills in children with ASD. Why use a robot to teach social communication? First, NAOs are autonomous, programmable humanoid robots, and their small size (22.8 inches) encourages children to engage with them, much as they would with a toy. In addition to the NAO's small size, its face is always neutral. When people interact with children, their facial expressions often convey approval, disappointment, or disapproval. The NAO's face is always neutral. NAO's behavior is predictable; it is exactly the same each time it presents the programmed lesson. The responses are simple, consistent, easy for children to understand, and build on interactions to improve social communication skills. NAO programming includes social cues, much like those people make in interactions and communication, such as eye and head movements, gestures, and a human-like voice (Sani-Bozkurt & Bozkus-Genc, 2023). Research finds that NAO robots can improve social skills (Kouroupa et al., 2022), reduce anxiety (Biagi et al., 2025), and increase engagement (Al-Nafjan et al., 2023) in children with ASD. However, there is limited data collected on NAO robots with children with ASD in educational settings (Nagy et al., 2024).

The NAO robot supports various programming languages and includes pre-installed Choregraphe applications, such as the "Animal" suite and Tai Chi stances, which pair physical actions with synchronized audio. These behaviors—ranging from an elephant's trunk gesture to meditative movements—provide immediate engagement for classroom settings. For educators without a programming background, the Choregraphe visual interface and RobotLAB's expanded libraries offer an accessible way to develop custom, drag-and-drop instructional lessons tailored to the sensory and learning needs of children with ASD.



NAO Robot as an Instructional Strategy

For three years, this NAO robot (pictured left) has been in elementary schools, engaging preschool and lower elementary students with ASD as an intervention strategy to improve their social communication skills. Engaging students with ASD at the start of the school day is found to maintain social connections and initiate communication throughout the school day (Sparapani et al., 2015). In many schools, the day begins with the flag salute. To encourage children with ASD to participate in daily routines and activities, the NAO was programmed to teach saluting-the-flag behaviors. NAO performs each of these actions as it tells children to face the flag, place their hands over their hearts, and stand as the Pledge of Allegiance is recited. As children with ASD imitate the NAO and follow its instructions, they are building skills that allow them to engage in a classroom activity and develop a sense of belonging.

Through integrating familiar music and synchronized movement into its programming, the NAO robot serves as a social communication stimulus for preschoolers and early elementary students with ASD. Activities such as the "ABC" or “Wheels on the Bus” songs use children's familiarity with the music to capture their attention and trigger imitation behaviors, ranging from vocal participation to mirrored physical gestures. This shared rhythmic activity transforms a simple recording into an engaging, predictable environment where children can safely practice essential motor imitation and social interaction skills.

While simpler songs like the "ABC" and “Wheels on the Bus” songs build on familiarity, the NAO robot’s performance of more complex routines—such as dancing to the elaborate choreography of Michael Jackson's song "Thriller"—serves a distinct therapeutic purpose by capturing attention through high-intensity novelty. Although the "Thriller" choreography involves musical and rhythmic patterns that may be less familiar to young children, its highly stylized, iconic movements and dramatic tempo changes are exceptionally engaging for students with ASD. This visual and auditory spectacle acts as a powerful "sensory hook," effectively anchoring a student’s attention for learning. By relying on the robot's ability to execute these intricate, repetitive, and predictable motor sequences, a high-interest experience facilitates joint attention and provides a bridge to more demanding social and academic tasks later in the day.

For higher-functioning elementary students with ASD who are developing foundational literacy, the NAO robot can be programmed as an interactive reading partner that models essential decoding strategies. Children with ASD follow along in a book that the robot reads aloud. The robot can be programmed to pause when encountering complex or unfamiliar vocabulary, providing a clear, step-by-step demonstration of structured literacy skills for sounding out unknown or unfamiliar words. An example would be the robot sounding out the word inventor. The robot stops, thinks, then says, “I know the 'in' at the beginning of the word spells the word 'in' and the 'or' at the end of the word is 'or '. Because n and t are two consonants together, the syllable should be broken there, so the t goes with or and makes tor. The letters v, e, n use the short e sound, so it sounds like ven. If I put it all together, it is in–ven–tor–-inventor.” This modeling is particularly effective for students with ASD, as the robot provides a consistent, non-judgmental, and predictable environment for learning. By seeing and hearing the NAO apply structured literacy rules and syllable division in real time, students with ASD are encouraged to mirror these behaviors in their own reading, transforming a potentially frustrating academic task into an engaging exercise that builds both reading fluency and the "momentum" of early academic success.

NAO brings joy to children, who display big smiles when they see the robot being carried into their classroom. For one verbal preschool girl with ASD, the NAO acts as a social mediator, bridging the gap between isolation and engagement. Her ritual of sitting on the floor with her feet against the NAO’s and putting her hands on either side of the NAO’s cheeks and looking straight into its eyes is a sophisticated level of dyadic engagement. In these moments, she is not just playing; she is practicing the core components of social communication by intentionally reaching out and seeking a shared connection. This initial interest in "the other" was further demonstrated when she spontaneously jumped up and down and clapped, exclaiming, "Robot, robot!" Such exciting displays of joint attention and expressive language mark a critical developmental transition from isolated play toward active interaction with the wider world.

The effectiveness of the NAO as a social bridge is further demonstrated through its capacity for predictable, physical modeling. For one non-verbal kindergartner with ASD, the robot’s "Animal" behavior suite—specifically the elephant gesture—provided a recognizable physical action. By immediately signing "elephant" upon the robot's arrival in his classroom, the little boy utilized a shared physical vocabulary to initiate a social greeting. This interaction is significant because it illustrates generalization: the kindergartner did not just mimic the robot in isolation; he used the learned sign to engage both the NAO and the educator simultaneously. Because the robot's movements are precisely repeatable and programmed, they offer a high degree of "communicative safety," allowing the kindergartner with ASD to confidently transition from internal recognition to active social outreach.

The impact of the NAO is most evident when traditional instructional methods fail to reach a student. For one non-verbal kindergartner with ASD who initially ignored standard routines like the flag salute and the ABC song, the robot's ability to pivot to high-interest, sensory motivators proved to be a turning point. When "Thriller" began, the student's focus shifted; he started moving to the music and signed "more" as soon as the song ended. By the third repetition, he was actively imitating the robot's dance moves, and the look of total delight on his face said it all. This worked because the NAO provided a visible, predictable beat, making it easier for the student to coordinate his movements. By matching his love for music with the robot's precise, repeatable gestures, the intervention helped bridge the gap created by his social withdrawal. The NAO served as a "social hook," drawing him into the moment, turning a solitary interest into active engagement and a shared success for the whole classroom.

The NAO can be used as an instructional strategy for children with ASD by implementing pre-installed programs like the 'Animal Suite,' stories, or songs. While simply replicating the exact lesson works well for some, each program can also be adapted to meet individual student's needs—from modifying physical movements to align with a student's mobility to adjusting wait times and speech rates for better processing.

Limitations

While the NAO demonstrated clear engagement, certain practical constraints remain. The high cost of the NAO and the significant time required to program lessons can be a barrier for schools with few extra staff or resources. Choregraphe programming is time-consuming but can be self-taught with resources available online and through RobotLab. Acknowledging these hurdles is essential for the future development of more accessible robotic solutions.

Conclusion

Ultimately, the use of NAO to improve social interaction for children with ASD transforms a theoretical tool into a practical catalyst for joy and engagement. These simple yet profound interactions demonstrate the robot's potential to serve as a communication bridge, allowing students with ASD to explore their world with newfound curiosity and confidence.

Looking forward, this work suggests several opportunities for the wider educational community. Teacher preparation programs might consider how hands-on experience with assistive robotics could be woven into their curricula, perhaps focusing on modular strategies that allow future educators to replicate or adapt existing tech with ease. Similarly, while hardware costs remain a factor, school districts could explore investment in these tools as a long-term support for student social growth. By viewing technology not just as a luxury but as a flexible resource tailored to individual needs, we can move closer to classrooms where every student has the support they need to thrive.

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