The Effect of Robot Mediated Instruction on Children with Autism Spectrum Disorder

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Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by persistent deficits in social communication and interaction, along with restricted and repetitive behaviors [1]. Recent data estimate that approximately 1 in 36 children in the United States are diagnosed with ASD, highlighting its growing public health significance [3].

Children with ASD often experience difficulty participating in group learning environments, including challenges with peer interaction, instructor communication, and sustained attention [1]. Educational interventions have increasingly emphasized structured, evidence-based approaches to improve social engagement and adaptive functioning [2].

Social robots have emerged as a novel tool within this framework. While prior research demonstrates benefits in one-on-one settings, less is known about their effectiveness in group-based instruction, where shared attention and peer dynamics add complexity [2].

Aims and Objectives

The aim of this study was to directly compare robot-led and human-led group instruction ("Circle Time") in children with ASD. Specifically, we sought to evaluate differences in:

- Engagement
- Communication
- Affective responses
- Task performance

By analyzing these classroom-relevant learning behaviors, this study aims to determine whether robotic instruction can serve as a viable alternative or complementary approach to traditional human-led instruction in group therapy settings.

Methods

Six children with ASD participated in structured group instructional sessions ("Circle Time") led either by a social robot ("Pepper") or a human instructor. Each child attended 10 robot-led and 10 human-led sessions over a six-month period. Sessions focused on practicing classroom behaviors such as following instructions, engaging with peers, and maintaining attention.

All sessions were video-recorded. Behavioral measures—including engagement, communication, affect, and task performance—were coded from Session 1 and Session 10 in each condition. Trained observers established inter-observer agreement (IoA) using Cohen's Kappa, requiring ≥80% agreement prior to independent coding. Discrepancies were resolved collaboratively.

Due to the small sample size and non-normal data distribution, the Wilcoxon Signed-Rank Test was used to compare behavioral outcomes between robot-led and human-led sessions. A Bonferroni correction was applied to adjust for multiple comparisons. Statistical significance was set at $p < 0.05$.

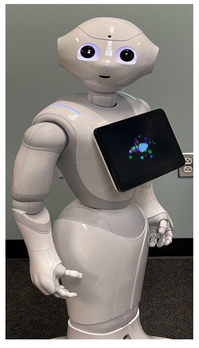

Fig. 1 "Pepper" robot used for instruction

Results

Thirteen behavioral metrics were analyzed to assess changes across instructional conditions. After Bonferroni correction, the adjusted significance threshold was 0.00192.

No statistically significant differences were observed between robot-led and human-led instruction across any behavioral measure. For example, the corrected p-value for positive emotional expression was 1. All adjusted p-values exceeded the significance threshold.

These findings suggest that instructor type did not significantly influence engagement, communication, affect, or task performance in this sample.

Fig. 2 Robot-led instruction

Fig. 3 Human-led instruction

Conclusions

Robot-led group instruction performed comparably to human-led instruction across all measured behavioral domains.

Given the rising prevalence of ASD [3] and the ongoing need for scalable, structured educational interventions [2], robot-assisted instruction may represent a promising complementary strategy. While robots may not fully replicate the nuanced social responsiveness of human instructors [1], their predictability and consistency may offer meaningful benefits within structured group settings.

Future research should explore hybrid human–robot instructional models and larger, longitudinal studies to better understand long-term clinical and educational impact.

References

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