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The Future of Robotics in Special Needs Education

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A B S T R A C T

The integration of robotics in education has garnered increasing attention, particularly in the realm of special needs education. As technology evolves, so does its potential to enhance learning experiences for students with disabilities. This letter explores the current state and future prospects of using robotics in special needs education, drawing on recent research to highlight both the challenges and opportunities. The future of robotics in special needs education holds immense promise. By enhancing academic skills, boosting motivation and engagement, and supporting social and emotional development, robotics can significantly improve the educational experiences of students with disabilities. However, to realize this potential, it is essential to address the challenges related to design, accessibility, and educator training. Continued research and innovation will be crucial in ensuring that robotics can serve as an effective tool in special needs education, providing tailored support that meets the diverse needs of all students.

Keywords: *Future of Robotics, Individuals with Special Needs, Robotics in Education.*

The integration of robotics in education has garnered increasing attention, particularly in the realm of special needs education. As technology evolves, so does its potential to enhance learning experiences for students with disabilities. This letter explores the current state and future prospects of using robotics in special needs education, drawing on recent research to highlight both the challenges and opportunities.

Educational robots have shown significant promise in enhancing various skills among students, including those with special needs. Al-Nawaiseh (2024) demonstrated the effectiveness of using educational robots to enhance engineering mathematics skills among basic school students. This study underscores the broader potential of robotics to improve academic performance in specialized subjects (Al-Nawaiseh, 2024).

In the context of special needs education, Battista et al. (2020) explored teachers' opinions towards educational robotics for special needs students in Italy. The study found that teachers generally hold positive views about the potential of robotics to support learning, highlighting the flexibility and adaptability of robots in addressing diverse educational needs (Battista et al., 2020).

Robotics can also play a crucial role in boosting motivation and engagement among students. Coşkunserçe (2021) investigated the impact of teacher-centered robotics activities in science lessons, finding that such activities significantly enhanced students' motivation, satisfaction, and science skills. This finding is particularly relevant for special needs education, where maintaining student engagement can be challenging (Coşkunserçe, 2021).

Similarly, Priambodo (2023) examined the impact of mBlock interface design on student interest and motivation in primary school robotics. The study showed that an intuitive and engaging interface could significantly increase student interest, suggesting that thoughtful design is critical to the successful implementation of robotics in education (Priambodo, 2023).

Beyond academic benefits, robotics can also support the social and emotional development of students with special needs. Garnier et al. (2023) conducted a study on the use of a humanoid robot in a French preschool class for autistic children. The educators reported that the robot helped improve social interactions and engagement among the children, facilitating a more inclusive classroom environment (Garnier et al., 2023).

Khaksar et al. (2019) identified critical success factors for the application of social robots in special developmental schools, emphasizing the importance of customization and user-centered design to meet the unique needs of students. These findings highlight the potential of robotics to provide tailored support that addresses both educational and social-emotional needs (Khaksar et al., 2019).

While the benefits are clear, the implementation of robotics in education is not without challenges. Li (2024) examined the effects of communication features of educational robots on students' cognitive load, attitudes, and learning performance. The study found that poorly designed communication features could increase cognitive load, negatively impacting learning outcomes. Therefore, careful consideration of robot design and functionality is essential to ensure they are effective educational tools (Li, 2024).

Ensuring that robotics contributes to accessibility and inclusion is another critical consideration. Syriopoulou-Delli and Gkiolnta (2021) explored the role of robotics in the inclusion of students with disabilities in special education. They found that while robotics can significantly enhance inclusion, there are barriers such as cost, technical complexity, and the need for specialized training for educators. Addressing these barriers is crucial for the widespread adoption of robotics in special needs education (Syriopoulou-Delli & Gkiolnta, 2021).

Effective integration of robotics in special needs education requires adequate training and support for educators. Lemaignan et al. (2022) emphasized the importance of viewing social robots as teaching aids or resources external to the classroom. Educators need proper training to effectively incorporate these tools into their teaching practices, ensuring they can maximize the potential benefits for their students (Lemaignan et al., 2022).

As robotics technology continues to advance, its applications in special needs education are likely to expand. Hendrik et al. (2022) discussed a new robotic learning activity design aimed at increasing figural creativity, highlighting the potential for robotics to support creative thinking and problem-solving skills. These advancements suggest a future where robots are integral to a wide range of educational activities, tailored to meet the diverse needs of special education students (Hendrik et al., 2022).

The future of robotics in special needs education also includes the development of collaborative learning environments. Coufal (2022) explored project-based STEM learning using educational robotics, finding that such approaches can enhance problem-solving competence

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among students. Collaborative projects involving robotics can foster teamwork, communication, and critical thinking skills, providing a holistic educational experience (Coufal, 2022).

Robotics offers the potential for highly personalized learning experiences, adapting to the individual needs and learning styles of students. Chiang et al. (2022) developed and validated a questionnaire for assessing perspectives on the World Robot Olympiad, finding that participants appreciated the personalized learning opportunities provided by robotics competitions. This trend towards personalization aligns with the broader educational goal of meeting each student's unique needs (Chiang et al., 2022).

The future of robotics in special needs education holds immense promise. By enhancing academic skills, boosting motivation and engagement, and supporting social and emotional development, robotics can significantly improve the educational experiences of students with disabilities. However, to realize this potential, it is essential to address the challenges related to design, accessibility, and educator training. Continued research and innovation will be crucial in ensuring that robotics can serve as an effective tool in special needs education, providing tailored support that meets the diverse needs of all students.

Authors' Contributions

Authors equally contributed to this article.

Declaration

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Declaration of Interest

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Ethics Considerations

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