European Schoolnet

Perspective

From research to policy action

One of European Schoolnet's key aims is to broker educational research findings and other evidence to our key stakeholders: Ministries of Education, schools, teachers, and industry partners. The European Schoolnet **Perspectives Series** is one way through which we achieve this.

The issues aim to:

- Summarise research evidence from key studies on innovation in education.
- Translate this evidence into concrete ideas for policy action.
- Conclude with the implications of the evidence for using technology in teaching and learning.

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Inclusive Digital Education: The role of social robots

Introduction

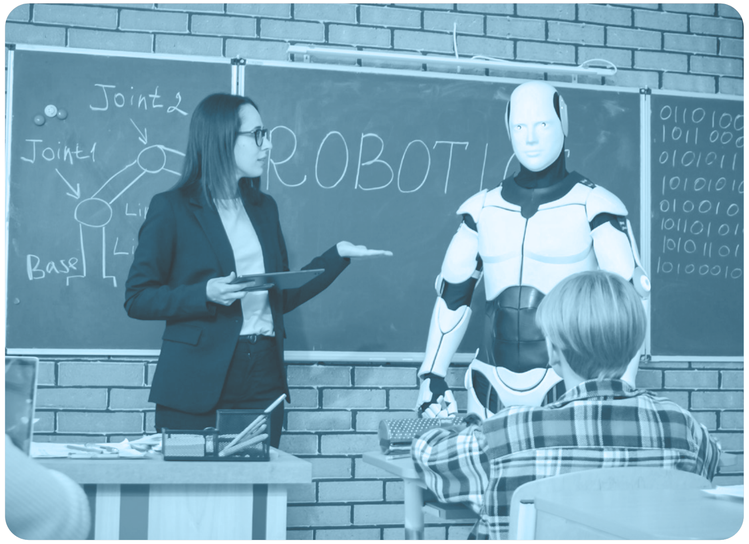
The impact of COVID-19 on inclusive education was clear with the school-reopening, where schools were unprepared to meet the needs of the vulnerable students (OECD, 2023). The absence of targeted measures to support vulnerable learners upon their return in schools continued to highlight the inequities in education as disadvantaged students exhibited lower levels of motivation upon their return to school compared to their peers. (Lucas, Nelson and Sims, 2020)

The challenges that online learning introduced in schools were nevertheless accompanied by opportunities, as a new era of digital education was coming closer for students globally (European Digital Education Action Plan, 2020). The COVID-19 experience impacted the policy developments across EU Member States and sparked discussion on addressing the needs of vulnerable learners in digital education (EC, 2021).

The global crisis prompted Ministries of Education to begin investing in a systematic way in digital equipment for schools and teacher training. However, the real issue surfaced almost a decade ago when the digitalization progress revealed that education was falling behind in preparing students with the skills demanded by the job market, with disadvantaged students lagging even further behind (OECD, 2019; OECD, 2021).

The digital transformation of education must ensure that all children, from the earlier possible stage, can develop digital competences aiming to successfully participate in education and labour market (EC, 2020). Consequently, this transformation encompasses challenges for students with special education needs (SEN), students coming from migrant or refugee background and students coming from lower economic backgrounds (OECD, 2021).

According to multiple publications, robots are among the digital pedagogies that might transform education in the future (Sayeda, 2020). A "social robot is a robot which can execute designated tasks, and the necessary condition turning a robot into a social robot is the ability to interact with humans by adhering to certain social cues and rules" (Yan et al., 2014; Sarrica et al., 2019). They are typically equipped with Artificial Intelligence (AI) and sensors that allow them to interpret social cues and respond appropriately in real-time (Breazeal, 2003). However, some social robots operate with pre-programmed scripts that don't require advanced AI. Social robots are not intended to replace teachers but to assist students with specific learning tasks, much like personalization tools (Belpaeme and Tanaka, 2021)



Social robots, Artificial Intelligence and Applications in Education

Social robots are designed to complement teachers by helping students with specific learning tasks, similar to how personalization tools' function. Personalization tools in education are designed to tailor learning experiences based on students' needs and different ways of learning. Social robots optimize learning by ensuring that each student receives support that is most appropriate for their current abilities. They serve as teaching assistants, much like how computers contribute to learning in their own unique manner (Belpaeme and Tanaka, 2021).

OECD working paper on the potential impact of Artificial Intelligence (AI) on equity and inclusion in education stands that AI -powered robots can aid in classroom management and provide support for students with special education needs (OECD, 2024). Additionally, AI-driven tools for curating learning materials can customize and expand educational content, helping to bridge language and cultural gaps. The European Agency for Special Needs and Inclusive Education also emphasizes that robots are playing an increasingly significant role in inclusive education by providing personalized assistance (Weber et al., 2022).

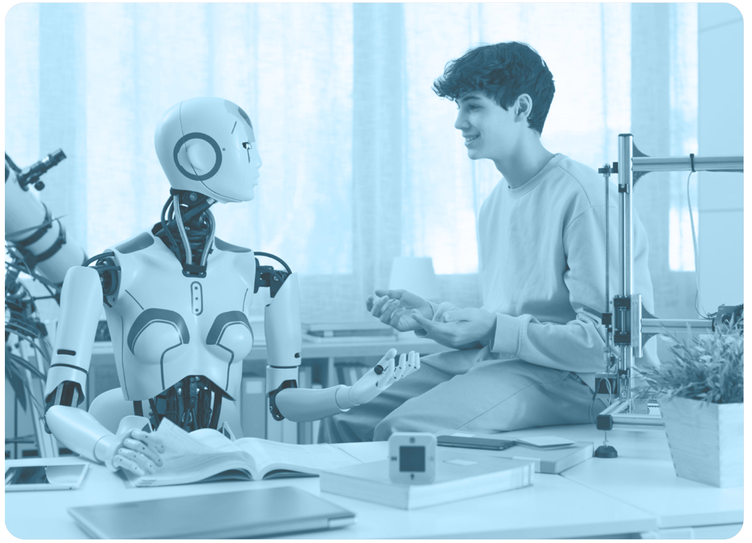
AI-powered robots offer numerous advantages, including the development of social skills and the provision of personalized learning support (Jones & Smith, 2020). When used under the supervision of teachers or school staff, these robots can address various learning needs, particularly for students who require emotional or behavioural support (Miller et al., 2019). Studies have shown that robots are effective in assisting students with neurodevelopmental and emotional disorders (Garcia & Lee, 2022). Systematic reviews in the field of social robots for educational purposes have highlighted a growing focus on their application for students with special needs, particularly those with autism (Papakostas et al.,2021).

Research has shown that both early childhood (Fridin, 2014) and autistic students achieve improved learning and social outcomes when using social robots as tutors (Fachantidis et al., 2018). Teaching and enhancing soft skills and social skills is particularly beneficial for autistic children. For example, the NAO robot and similar robots can personalize interactions by integrating the learner's interests, hobbies, and the names of family members or friends, which can significantly boost student motivation and learning outcomes (OECD, 2021; Belpaeme et al., 2018). Other robots are designed specifically to enhance learning for autistic students, positively impacting their emotional well-being and development (Lemaignan et al., 2022; Cabibihan et al., 2013). The use of these social robots has been shown to improve communication, social interaction, and adaptive behaviour in autistic children (Scassellati et al., 2012).

Furthermore, studies have revealed that social robots effectively support language development in both children with special needs and migrant students, helping them overcome language barriers and improve their linguistic skills in an interactive and supportive environment (Meghdari et al., 2013; Lemaignan et al., 2022). For instance, robots like NAO have been used to support second-language learning among young migrant students in the Netherlands and Norway, contributing to systematic training and language retention through repeated interactions (Petrovic et al,2021, Fuglerud and Solheim,2018).

The use of social robots in educational settings can promote inclusivity by offering one-on-one tutoring, something that is particularly beneficial for students with diverse educational needs. These robots provide consistent, non-judgmental feedback and adjust their teaching pace according to the learner's proficiency, making language learning more accessible to children from migrant families or those with special needs (Rohlfing et al., 2022).

Overall, social robots enhance both engagement and effectiveness in language learning, ensuring that all students, regardless of background, could succeed in increasingly diverse classrooms.



A series of studies have been focusing on the emotional development support social robots are offering to children, in particular autistic children. For example, Papazoglou, Karagiannidis, and Mavropoulou (2021) assessed the use of educational robotics in primary schools in Greece, specifically focusing on its effects on the social status of autistic learners. Before the intervention, these learners had low social status, but after the robotics intervention, their social engagement and status significantly improved.

Likewise, the role of educational robots in fostering empathy through realistic simulations in classroom settings, highlighting the potential for robotics to facilitate emotional learning alongside academic development (Bratitsis et al.,2020).

Beyond Special Needs Learners: How social robots can benefit the inclusive classroom?

Inclusive classrooms are mixed ability settings "where students with diverse abilities, including those with disabilities and those without, are taught together". It is designed to accommodate a range of learning needs, promoting equal access, participation, and achievement for all students" (UNESCO, 2009). Therefore, it is important that teaching materials are inclusive and accessible to every learner (UNICEF, 20219).

Research has shown that social robots can improve the learning outcomes not only for special needs students but also enhance the learning experience for all learners. In an intervention using the Daisy Robot for the inclusion of three autistic children, three typically developing (TD) children also participated. The TD children showed increased motivation and improved skills after the intervention. Remarkably, no misbehaviours or issues arose, indicating that their own development was not hindered (Pliasa et al., 2020). Similar studies have echoed these findings, showing that the use of social robots in inclusive environments benefits both autistic and typically developing students. For instance, a study by Kim et al. (2015) involved a robot-assisted program where TD children and autistic children engaged in joint activities. The TD children showed enhanced empathy and social interaction skills, while autistic students demonstrated improvements in social communication. The presence of social robots allowed TD children to act as mentors, fostering peer support without negative impacts on their own development.

Another study by Cabibihan et al. (2013) showed that robot-assisted interventions not only support the learning and social skills of autistic children but also improve the social skills of their TD peers. In this research, TD students became more inclusive and engaged with their autistic classmates, while their academic performance and classroom behaviour remained unaffected.

Despite the studies mentioned above and the well-established benefits of assistive robotics for children with disabilities, their role in fostering inclusive educational practices that benefit the entire classroom remains underexplored (Belpaeme et al.,2018, Díaz-Boladeras et al., 2023).

More studies, analysis and evidence are needed to ascertain how AI-powered tools and applications can improve learning outcomes. Implementation efforts should be grounded in benefit-risk analyses before being adopted at scale (UNICEF, 2021). These gaps suggest the need for a more holistic approach to integrating robotics into educational settings, one that accounts for both the advantages and the challenges of these technologies within inclusive teaching frameworks.

Policy recommendations

Policymaking and practice must seriously consider the ethical implications of using AI and other new technologies in education, particularly in inclusive settings. Policy makers must ensure ethical use of new technologies and protect all learners from the digital divide. Ethical considerations in the use of social robots in educational settings involve concerns about privacy, the potential for dependency, and the emotional impact on students (Sharkey, 2016). The need for careful evaluation of how robots affect students' social and emotional development, particularly in vulnerable groups, as well as the broader societal implications of their integration into classrooms should be considered at policy level as well (Mubin et al.,2013).

Technologies like artificial intelligence (AI), virtual and augmented reality may considerably influence inclusive digital education in the future. Therefore, research into their use, effectiveness, accessibility, benefits and risks is important. AI technology's personalisation and adaptation opportunities may be key to achieve a universal design and use for educational tools. Teachers should easily adjust robots feature to cover the diverse needs of all students.

EdTech companies often face challenges due to a lack of pedagogical expertise within their teams. Especially in the field of inclusive education the gap can be dramatically expanded as edtech developers are unaware of the particular needs of students and how educational interventions can be better applied in the classroom. Hence, there should be more collaboration between teachers and students and the industry responsible for designing robots.

Policies at EU level have clear intention to guarantee that age-appropriate materials are available for children in education settings (UNICEF, 2023). Following this explicit goal, similar targets should be developed for inclusive digital materials.

Finally, governments could play a pivotal role in advancing the integration of robotics in education by supporting research efforts. Small-scale testing interventions in schools across the country should be made mandatory, with the aim of assessing the usability of robots in mixed classrooms and gathering teachers' perspectives on their effectiveness.

Policy Actions

Encourage the development of inclusive digital learning environments by establishing robust policy frameworks and ensuring equitable access to digital tools suitable for every student.

- Policy frameworks on digital education should prioritise inclusivity in digital tools and materials.
- Invest in education technology that can be tailored to the needs of every learner.
- Create mechanisms to monitor and evaluate the effectiveness of digital technologies for education purposes.
- Introduce comprehensive guidelines for school staff to ensure equitable access to technology, data privacy protections, and safeguards against bias in educational technologies.
- Accelerating the deployment of social robots in mixed classrooms through pilot programs before making nationwide or regional purchases.
- Develop indicators to measure the effectiveness of digital tools and robotics in the classroom, with a strong emphasis on inclusion.
- Foster the development of online materials that allow for reasonable adjustments to be made by teachers, students, and parents, ensuring that students with needs can participate in education on an equal basis.

Erasmus+ project example

Educational Robotics to Support Inclusive Education in Primary Schools

The aim of the project is to investigate how interaction with educational robots can promote and support learning processes of technology, programming and socio-emotional skills in children. Our target group is 8- to 9-year-olds, in primary education, focusing on inclusive classes for all children.

Home - Robots4Inclusion

2023-1-DE01-KA220-HED-000154146

The Haru Robot- Honda Research Institute Japan and European Commission's Joint Research Centre

Haru is a prototype robot that aims to stimulate children's cognitive development, creativity, problem-solving and collaborative skills. Once fully developed, it is intended to be used in the home, as well as in educational settings by children from different cultural backgrounds. As part of the robot's design phase, children in Japan and Uganda were consulted to assess how they viewed concepts of fairness and explainability, which varied widely. The children's participation helped raise awareness of emerging ethical considerations and build the technical requirements and conceptual framework that will guide the integration of children's rights in social robotics and embodied AI.

UNICEF-Global-Insight-Responsible-AI-framework-case-study-HRI-JP-JRC-2021.pdf

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European Schoolnet's mission is to support ministries of education, schools, teachers, and any stakeholder involved in the transformation of education processes in Europe to improve the quality of education for all. The organisation represents the voice and interests of its members – ministries of education from more than 30 European countries – and offers them a space to debate, exchange best practices, learn from each other, and collaborate to find common solutions to key societal challenges impacting education.

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