Journal of Modern Education Review, ISSN 2155-7993, USA
September 2021, Volume 11, No. 9, pp. 931–936
Doi: 10.15341/jmer(2155-7993)/09.11.2021/003

http://www.academicstar.us

Social Robots and Special Education

Vasiliki Katsarou
(Ambassador Etwinning, Greece)

Abstract: This paper deals with the topic "social robots and their use in special education and training". At first, we tried to define the scientific field of social robots and their use as an educational tool. Then we describe the characteristics of social robots and we refer to those robots that are widely used in experimental research for educational purposes in children with special needs or abilities. Finally, through the literature review of the last decade we tried to depict the beneficial and positive results of the use of social robots mainly in the education of children with autism, learning difficulties and disabilities, as well as to depict the future perspectives and expectations that are created.

Key words: social robots, autism, special education, interaction

1. Social Robotics

The term "robotics" includes a broad field with a variety of sub-regions. One of these is called social robotics and involves robots that engage in some form of social interaction with humans such as gestures, speech or other forms of communication (Fong, Nourbakhsh & Dautenhahn, 2003). It is a rapidly emerging field and includes robots designed for assistance and training through advanced user-based interaction (eg teaching, physical therapy, daily assistance, emotional expression) and through multimodal interfaces (speech, gestures and devices) (Feil-Seifer & Mataric, 2005). This field is an interdisciplinary field as the development of social robots requires multifaceted expertise and shares its challenges with robotics, physiology, psychology and sociology, among other fields. On the other hand, from a technological point of view, fields such as mechatronics, artificial intelligence, and real-time control issues work together in robotics (Tapus, Mataric & Scassellati, 2007).

The use of robots as an educational tool is quite widespread worldwide but is still limited in special education. Especially in the field of special education is under consideration as it is considered that robots are expensive and have limited capabilities. However, studies show the effectiveness of social robots in specific areas (Kaburlasos & Vrochidou, 2019) while these "new friends" are evolving into a more upgraded, available and affordable product. In recent years there has been an increase in the use of social robots in the education of people with disabilities, such as people with dementia, hospital children and children on the autism spectrum disorder (Heerink, Vanderborght, Broekens & Albó-Canals, 2016).

In the field of special education with the involvement of the social robot the research includes the following categories:

1) Autism Spectrum Disorder.

Vasiliki Katsarou, MSc, Kindergarten Teacher, ICT Educator; research areas: basketball anthropometric and physiological characteristics, plyometric training. E-mail: vakatsarou@gmail.com.

2) Attention Deficit Hyperactivity Disorder.
3) Motor impairments.
4) Hearing loss.

However, the majority of research focuses mainly on therapeutic applications for children with developmental disabilities, mainly autistic spectrum, focusing on the development of social skills, communication and collaboration. Humanoid robots such as Nao, or Kaspar are already used in the education of children with these developmental disorders, and researchers have shown that they can help them to improve their engagement and induce new social behaviors in these children (Kaburlasos & Vrochidou, 2019). We therefore consider it is important at this point to refer to this developmental disorder.

2. Autism Spectrum Disorder

Autism Spectrum Disorder is a disorder that is affecting more and more children. It is characterized by severe deficits in the areas of social interaction and communication skills and leads to isolation and extreme failure of the socialization process. In addition, it is characterized by stereotypical forms of behavior, interests, activities and stereotyped movements which are often repeated with great obsession. The language development of these children is severely deficient except in children with Asperger's disorder, who have the same symptoms as children with autism but they do not have language development deficits. About the half of autistic children do not develop speech or may utter individual words and phrases. The other half develop a special form of speech with many peculiarities. Also, their speech is non-functional. However, their speech, when it exists, is not a means of communication, because they are usually not in mood for communication. In addition, their level of intelligence ranges from the highest levels to the most severe forms of mental retardation (Kakouros & Maniadaki, 2006, pp. 320-321).

3. Form and Characteristics of Social Robot

The most common forms of robots used to treat autism are the human form (Android), the animal form, and the form of a simple machine. In order for a robotic tool to be included in an educational programm for children with autism it must meet certain criteria such as the ability to interact with the environment and the people around it, as well as to use prompts for social interaction with users. Robots are used:

- as a model that indicates social behavior
- as a toy object that aims to enhance the child's interaction with another person
- as a mediator that helps children express emotions and behaviors that they would not easily display when interacting with a human partner (Scassellati, Admoni & Mataric, 2012).

The appearance of robots plays an important role in the interaction as it is the first thing one notices when one sees a robot. Some have a realistic human appearance while others have a mechanical form, others have a cartoon form and others a pet form. The appearance of the robot should be pleasant to the child, not to cause him anxiety and fear, in order the child can deal with and interact with it. The main element that a robot should have to enhance social skills are the characteristics that refer to a human face (mouth, eyes, nose, etc.). The presence of human characteristics allows the robot to develop eye contact with the child. Another element that a robot should have is movement and the ability to interact with humans verbally. If the researcher's goal is to develop social skills it is important the robot to be constructed with the ability to interact. The trainer can be in the same room

with the child or in another room and control the movements of the robot which is used in the intervention program with a hidden system or device without the student takes notice. This method of remote control of robots is the “Wizard of Oz” technique and is very spread method (Scassellati et al., 2012).

4. Social Robots Used in Experimental Research

Some of the most popular social robots used for educational purposes are:

1) Nao is a human-sized plastic robot the size of a child and can cover a lot of information about the environment using sensors and microphones. It is considered suitable for use in educational experiments of children with autism.
2) Kaspar is also a humanoid robot in the form of a little boy. He does not move in the room but moves his head, hands and eyes. His face can display a range of simplistic expressions, Also, he is able to respond to children’s touch, and has the ability to play recorded messages and songs in order to fascinate children to play and interact with him, but he does not have the ability to understand oral speech.
3) Pleo is a dinosaur robot which behaves like a pet. It moves autonomously, expresses emotions with movements and sounds, responds to the touch of children or to various interactions such as caressing or feeding. It interacts with sounds, touch and can ask the child to feed. It gives positive reinforcement when the child responds correctly.
4) Keepon is a snowman-like robot, mounted on a black cylinder which contains the robot’s engine and controllers. It has two modes of operation: touch and dance. In the touch mode it reacts to the person with the touch while in the dance mode it dances in a synchronized rhythm with music. It is designed to interact emotionally with the user as well as deal with distraction problems.
5) Probo has the shape and texture of a stuffed animal, has a trunk with various sensors on it that participates in the interaction. He does not have the ability to move but he has the ability to be hugged by the child during the interaction. The main feature is the facial expressions that help children in social interaction and in the understanding of the emotions.
6) Face is an Android with a passive body and an active head. It has engines for simulating and expressing six basic emotions (happiness, sadness, surprise, anger, disgust and fear). It is an artificial human face quite realistic, and can interact with the external environment through expressions and emotions without oral speech. The effectiveness of its use is based on the imitation of predetermined stereotypical behaviors and constant interaction with its environment. It is used to improve the social and psychological abilities of children with autism.
7) Robota is the name of a series of mini humanoid shaped robot dolls whose physical features resemble those of a human baby. They are used as imitation robots to assess children's ability to imitate and to teach them simple coordinated behaviors. They can engage in complex human interactions that include speech, vision, and body imitation.
8) The Bandit Robot is a half Android from the middle and up, it has wheels to move and a space above the wheels where various sensory instruments can be adjusted. It is used to develop social behaviors in children with autism as well as an assistive robot in elderly people with physical exercise issues (Martinez-Martin, Escalona & Cazorla, 2020; Pennisi, Tonacci, Tartarisco, Billeci, Ruta, Gangemi & Pioggia, 2016).

5. Social Robots and Special Education

In recent years, the use of the social robot has become popular in the education and diagnosis of autism. The diagnosis of autism is usually made at the age of 3 years while the robot can achieve it from infancy by using eye patterns (Scassellati, 2007). Education focuses on improving children's communication and interaction skills, attention, response and cognitive flexibility (Scassellati et al., 2012).

Social interactive robots are used to communicate, express and perceive emotions, maintain social relationships, interpret physical conditions and develop social skills. They are tools for teaching skills to children with autism, to play with them and to provoke certain desirable behaviors in them. They create interesting, engaging and important interactive situations that cause children to interact with them (Cabibihan, Javed, Ang, & Aljunied, 2013).

The purpose of these robot-child interactions is to enable children to overcome their shortcomings and gain a better understanding of the world Also, the interactions aim to improve their social skills, to raise their emotional awareness and to communicate with the environment and people around them. To achieve these goals they engage children in enjoyable and exciting play activities, provide encouragement and positive feedback upon successful completion of a task, while training the child in social skills in order to extend these behaviors to their social peers. This is accomplished through pair sessions (Amanatiadis, Kaburlasos, Dardani & Chatzichristofis, 2017) or group therapy, where two or more children interact with the same robot or with multiple robots (triple interaction) (Amanatiadis, Kaburlasos, Dardani, Chat & Mitropoulos, 2020). Of course, the ultimate goal, as mentioned above, is to generalize these social skills to their social circle, which includes other children, family members, therapists and teachers.

Therapies using social robots have shown significant benefits and have shown their effectiveness in achieving positive results in patients, such as high enthusiasm, increased attention and increased social activity (Begum, Serna & Yanco, 2016). These results are explained by the fact that children with autism feel more comfortable interacting with the robot, because its behavior and reactions are more predictable (Scassellati, et al., 2012), while it is more easily accepted, compared to humans, by children with autism as it does not charge them emotionally (Cabibihan et al., 2013). Therefore, a child with autism can respond to a statement/gesture manifested by a social robot more easily than a statement/gesture manifested by a human. An additional advantage is the visual charm of the robot that attracts the attention of children with autism. In general, these robots tend to use bright colors, rotating mechanical parts, striking shapes, and lights. Another important feature of the robot is the individualized treatment for each child, according to the child's preferences, weaknesses, disabilities and needs while they are available around the clock (Cabibihan et al., 2013).

These robotic systems can be used to manage treatment sessions, collect data, analyze patient interactions, and generate information from this data in the form of reports and graphs. Therefore, social robot is a powerful tool for the therapist in order to monitor the child's progress while facilitating the diagnosis (Martinez-Martin et al., 2020).

As the research has shown the acceptance by parents as well as professionals is encouraging. They accept NAO as a means of social inclusion rather than social isolation of a child with autism spectrum disorder (Conti, Di Nuovo, Buono & Di Nuovo, 2017; Amanatiadis et al., 2017).

Social robots find application in other categories of developmental disorders such as attention deficit hyperactivity disorder. Vélez & Ferreiro (2014) showed that the use of social robots in individual and group

therapies improves children's attention. A social robot can be used as a part of pediatric therapy not only as a tool but also as an agent with the primary goal of speeding up treatment and not replacing it. The child considers the robot as a toy or a friend and creates a close relationship with it so that the treatment proceeds faster. The robot can guide tasks, and increase their complexity, while different types of therapeutic procedures can be performed using the robot's body movements and facial expressions, such as mimicry games that train children's coordination and imagination.

Also important are the positive findings in children with mobility problems as free play with the social robot provoked their mobilization and gave them opportunities for free play with family and friends as it is known that children with cerebral palsy have fewer opportunities for free game. Without opportunities for self-initiated and spontaneous play, children can develop a learned weakness and assume that they cannot perform a task, even though they may have the required physical abilities. The robots improved the children's enjoyment and play while using the Lego robot to interact with their toys and explore their natural environment in a playful way. At the same time during the free game they had the opportunity to practice their skills, to experience self-control and innate motivation while; they showed perseverance, concentration and creativity in problem solving, they led the game, enjoyed and derived great pleasure from their game (Ríos- Rincón, Adams, Magill-Evans & Cook, 2016).

Social robots could serve as assistants in teaching sign language to children with communication problems. In this case, the humanoid social robot acts as a social peer and helper to motivate hearing-impaired children, teach them non-verbal cues, evaluate each child's effort, and provide appropriate feedback to improve learning and recognition. of non-verbal gestures of children (Özkul, Köse, Yorganci & Ince, 2014).

References

Amanatiadis A., Kaburlasos V. G., Dardani C. and Chatzichristofis S. A. (2017). "Interactive social robots in special education", in: *2017 IEEE 7th International Conference on Consumer Electronics-Berlin (ICCE-Berlin)*, IEEE, pp. 126–129.

Amanatiadis A., Kaburlasos V. G., Dardani C., Chatzichristofis S. A. and Mitropoulos A. (2020). "Social robots in special education: Creating dynamic interactions for optimal experience", *IEEE Consumer Electronics Magazine*, Vol. 9, No. 3, pp. 39–45.

Begum M., Serna R. W. and Yanco H. A. (2016). "Are robots ready to deliver autism interventions? A comprehensive review", *International Journal of Social Robotics*, Vol. 8, No. 2, pp. 157–181.

Cabibihan J. J., Javed H., Ang M. and Aljunied S. M. (2013). "Why robots? A survey on the roles and benefits of social robots in the therapy of children with autism", *International Journal of Social Robotics*, Vol. 5, No. 4, pp. 593–618.

Conti D., Di Nuovo S., Buono S. and Di Nuovo A. (2017). "Robots in education and care of children with developmental disabilities: a study on acceptance by experienced and future professionals", *International Journal of Social Robotics*, Vol. 9, No. 1, pp. 51–62.

Feil-Seifer D. and Mataric M. J. (2005). "Defining socially assistive robotics", in: *9th International Conference on Rehabilitation Robotics, ICORR 2005*, IEEE, pp. 465–468.

Fong T., Nourbakhsh I. and Dautenhahn K. (2003). "A survey of socially interactive robots", *Robotics and Autonomous Systems*, Vol. 42, No. 3–4, pp. 143–166.

Heerink M., Vanderborght B., Broekens J. and Albó-Canals J. (2016). "New friends: Social robots in therapy and education", *Int J. of Soc. Robotics*, Vol. 8, pp. 443–444, doi: 10.1007/s12369-016-0374-7.

Kaburlasos V. G. and Vrochidou E. (2019). "Social robots for pedagogical rehabilitation: Trends and novel modeling principles", in: *Cyber-Physical Systems for Social Applications*, IGI Global, pp. 1–21.

Κακούρος Ε. and Μανιαδάκη Κ. (2006). Ψυχοπαθολογία παιδιών και εφήβων, Αθήνα: Τυπωθήτω-Γιώργος Δαρδάνος.

Martinez-Martin E., Escalona F. and Cazorla M. (2020). "Socially assistive robots for older adults and people with autism: An overview", *Electronics*, Vol. 9, No. 2, p. 367.

Özkul A., Köse H., Yorganci R. and Ince G. (2014, December). "Robostar: An interaction game with humanoid robots for learning sign language", in: *2014 IEEE International Conference on Robotics and Biomimetics (ROBIO 2014)*, IEEE, pp. 522–527.

Pennisi P., Tonacci A., Tartarisco G., Billeci L., Ruta L., Gangemi S. and Pioggia G. (2016). "Autism and social robotics: A systematic review", *Autism Research*, Vol. 9, No. 2, pp. 165–183.

Ríos-Rincón A. M., Adams K., Magill-Evans J. and Cook A. (2016). "Playfulness in children with limited motor abilities when using a robot", *Physical & Occupational Therapy in Pediatrics*, Vol. 36, No. 3, pp. 232–246.

Scassellati B. (2007). "How social robots will help us to diagnose, treat, and understand autism", in: *Robotics Research*, Springer, Berlin, Heidelberg, pp. 552–563.

Scassellati B., Admoni H. and Matarić M. (2012). "Robots for use in autism research", *Annual Review of Biomedical Engineering*, Vol. 14, pp. 275–294.

Tapus A., Mataric M. J. and Scassellati B. (2007). "Socially assistive robotics: Grand challenges of robotics", *IEEE Robotics & Automation Magazine*, Vol. 14, No. 1, pp. 35–42.

Vélez P. and Ferreiro A. (2014). "Social robotic in therapies to improve children's attentional capacities", *Review of the Air Force Academy*, No. 2, p. 101.