Robots and children learning differently: A brief review of robot applications for young children

Patricia Mui Hoon Ng

Associate Fellow
Register of Educational Therapists (Asia)

Abstract: This is a review of articles on robot applications used with children in the general population of early childhood (0 - 8) years for the potential benefits in using them in the education of today's children who need to be learning differently. As young children are growing up in an increasingly tech-savvy world, this review would serve to raise the awareness of robot applications developed for them. Based on collaborative efforts in function and design such as the use of puppetry, as well as curriculum design in areas such as behaviour modification, social or motor skills, numeracy, language and literacy through storytelling and/or games, the robot applications reviewed here have been found to present with great potential for a dynamic way to educate the young. Implications for use with children with special needs are discussed.

INTRODUCTION

Due to the similarities between virtual agents and robots, it is necessary to start with a technical distinction between them. According to Looije, van der Zalm, Beun, and Neerincx (2012), a virtual agent is not a robot but an animated virtual character (usually with anthropomorphic appearance) with artificial intelligence that is generated by a computer. The authors pointed out that embodiment is the key difference between a virtual agent and a robot. The similarity, on the other hand, as pointed out by Vitec Inc. (2016) is that both are embedded in a program with predefined scripts and responses. They can be powered by a knowledge base, which contains a wide-ranging list of possible different questions, answers and gestures, allowing them to respond to human input in a somewhat human way.

LITERATURE REVIEW

Robots as programmable toys

Bee-bot Pro-bot KIBO KIWI

Robots such as the Bee-Bots and Pro-bots (from TTS Group Ltd, UK), the KIBO (from KinderLab Robotics, USA) and the KIWI robotics kits (from Tufts University, USA) are examples of unscripted robots programmable by children for use in Problem-based Learning (PBL). This involves working out an answer to a question, then allowing the child to programme the robot to get to a specific location with the answer on a map. Language, literacy, numeracy or other subjects to be taught can be incorporated into the PBL curriculum.

Robots as teachers & autonomous humanoid social robots (HSRs)

EngKey Hanson Robokind Robovie Infanoid Nao Pepper

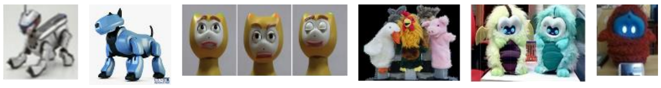
The EngKey 'robot' from the Korean Institute of Science and Technology (KIST), South Korea is an example of a teacher robot that functions as a tele-presence tool that brings English teachers located in the Philippines to the schools in South Korea. One of the earliest autonomous humanoid social robots (HSR) scripted for use with children is Infanoid (Japan). Following that was Robovie (Japan), then the Hanson Robokind Zeno R50 (University of Sheffield, UK) which has a realistic silicon rubber ("flubber") face that can be reconfigured. It is not only more life-like but is a smaller toy-like social robot that can be placed on a table. Another small humanoid social robot is NAO from Aldebaran Robotics, France. In a preschool project in Singapore, a larger HSR called Pepper (Aldebaran Softbank Robotics, France) was used with NAO. These HSRs were scripted for social interaction with children in activities such as story-telling, quizzes, and imitation and dance games.

Autonomous social robots as child-minders

H3 robot Irobi Keepon PaPeRo

Early models of autonomous social robots for child-minding came from Japan, such as the hybrid humanoid H3 robot; Keepon, a small (11 inches tall) yellow snowman-shaped tabletop robot; and PaPeRo - Partner-type-Personal-Robot. Sized a little larger than PaPeRo is IROBI from Yujin Robots, South Korea. The roles these robots play include preventing child-care accidents, performing emotional and attentional exchanges, taking digital photos, sending images by mobile phone and maintaining a virtual organizer.

Creature-like social robots



AIBO Genibo iCat Robotic puppets DragonBot Tega

Creature-like social robots include Sony's three models of 4-legged robotic dogs known as AIBO; a later version of a robotic dog called Genibo from South Korea; the iCat from University of Birmingham, UK; the DragonBot from MIT Media Lab, USA; the Show & Tell Robotic Puppets for preschool education from NTU, Singapore; and the Tega robot, also from MIT Media Lab, USA. The animal embodiments of these social robots may appeal to young children as common domestic pets. Besides, plush features enhance the entertainment value for children. These robots played roles ranging from teaching dance, playing chess, being a helpful companion, storytelling, and even recording data for children's language to be transcribed and analyzed for content and structure.

DISCUSSION & CONCLUSION

It has been reported that robots not only have the core advantage over virtual agents in terms of real-world interaction and manipulation, but the physical robot is also more appealing to user perceptions. There is also the unconscious effect of the presence of a physical robot, for example, the frequency and length of gaze of children is greater for a real robot than a virtual form of the same robot. In addition, when using real robots, the benefit to performance or other outcome is shown in several contexts: learning, motor skills, and long-term behaviour change.

The studies reviewed here show that all over the world, there is a myriad of uses for robots for children in the early childhood years. Robotics, in the form of programmable construction kits and social robots, could make as great a contribution to improving the quality of special needs education as well. "Technologies of this kind could enable educators to recognize children's individual needs at an early stage of education and to compensate for their diagnosed disabilities. Robotics could also empower special-needs children to experience success in the learning of those technical skills that are central to our technology-oriented society" (Virnes, 2008, p30).

REFERENCES

Looije, R., van der Zalm, A., Neerincx, M., & Beun, R.-J. (2012). Help, I need some body: The effects of embodiment on learning in children. Paper presented at the IEEE-ROMAN-12, Paris, France.

Virnes, M. (2008). Robotics in special needs education. Paper presented at the 7th International Conference on Interaction Design and Children, Chicago, USA.

VITEC Inc. (2016). Top 15 in 2015 – Trend #14 – Virtual Agents. Retrieved from http://www.vitecinc.com/top-15-2015-trend-14-virtual-agents/