Robot teachers: The very idea!

1 author:

Amanda Sharkey
The University of Sheffield
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Amanda Sharkey

Word counts:

Abstract (60 words) Insufficient attention has been paid to the use of robots in classrooms. Robot 'teachers' are being developed, but because Kline ignores such technological developments, it is not clear how they would fit within her framework. It is argued here that robots are not capable of teaching in any meaningful sense, and should be deployed only as educational tools.

Department of Computer Science, Portobello Rd, Regent Court, University of Sheffield, S1 4DP

a.sharkey@sheffield.ac.uk

Robot teachers: the very idea!

According to Kline, teaching behaviour is found in western and non-western human societies and in some non-human animals. Could robots also be said to teach?

Recent technological developments mean that robots are being used in classrooms as intermediary tools to explain concepts in mathematics and science and as a means of involving students in technology by building and programming robots (Mubin et al, 2013). There is also interest in the idea of robots actually doing the teaching. Kanda et al (2004) report a field trial in a Japanese elementary school in which two 'Robovie' robots spoke English to children that approached them. A test showed improvements in the English skills of children who frequently interacted with the robot. Movellan et al (2009) report a study in which a robot operated in an early education centre for 2 weeks was found to have improved toddlers' knowledge of targeted words. Other robot 'teachers' have been remote controlled by humans, sometimes under Wizard of Oz conditions in order to explore robot capabilities that are not yet available. The Saya robot has a female appearance and an emotionally expressive face and can be operated remotely. Hashimoto et al (2011) describe how it was used to deliver material about the principles of leverage to elementary school pupils. EngKey robots are deployed in South Korean classrooms to teach students English, delivering automated scripts for practicing pronunciation and conversation, and enabling telepresence communication between students and remote instructors in the Philippines. Yun et al (2011) report that they improved student performance.

Robots may be able to help second language learners, but should their behaviour be described as 'teaching'? Could a robot ever be said to offer *good* teaching? Also, should such developments be seen as progress, or something that we would do better to avoid?

Kline's article sheds some light on these questions, although she does not consider robot teachers, nor discuss the use of indirect forms of teaching and teaching tools such as books, or computer-aided instruction. In her framework, robot teaching seems to fall within the category of 'direct active teaching', and clearly it would be possible for a robot to convey new information to a pupil.

However, Kline also claims that direct active teaching requires the teacher to have the ability to 'identify and communicate the relevant information to the pupil'. Could a robot have such an ability?

Presumably a robot that delivered the same material regardless of the presence or composition of its audience could not be said to be actively teaching. For nonhuman animal behaviour to be counted as teaching, Caro and Hauser (1992) required that it should occur only in the presence of a naïve observer, and at some cost, or at least no immediate benefit, to the teacher.

There are measures that can enable a robot to detect the level of interest or engagement shown by a pupil. For instance, Mutlu and Szafir (2012) programmed a humanoid robot to tell a story to individual students, and used an EEG signal to monitor the student's attention. When brain signals indicated that the student's attention had dropped the robot would raise its voice or use arm gestures to regain the student's attention.

A robot that could adapt its instructional behaviour depending on the response of its pupils might be said to be exhibiting a form of teaching, as is the case for some examples of nonhuman animal behaviour. The idea that a robot could identify what a pupil needs to know seems more challenging. As non-humans, how could they determine what human children need to know, or have the intention to pass on the information that is needed to accomplish the tasks required in human culture? Similarly, because robots are not subject to evolution in the way that living entities are, they cannot evolve the knowledge of the material that needs to be taught to solve an adaptive problem.

Kline's framework moves away from the requirement for teachers to have a theory of mind and particular mental capacities. She is more concerned to encompass teaching behaviours found in both non-human animals and in humans, and to unify different approaches to the study of teaching. A consequent problem is that her framework loses sight of the specialised human requirements for *good* teaching, and might even been seen as opening the door to an acceptance of the idea of robot teachers. However there are many requirements for being a good teacher that a robot is unlikely to be able to fulfil. As acknowledged by educational theorists with a mentalistic perspective, a good teacher will identify the zone of proximal development for a child based on a detailed understanding of that child's capabilities and will be able to teach them just what they need to know, just when they need to know it (Pelissier 1991). A good teacher also helps to socialise their pupils, acting as an attachment figure and as a role model, and inspiring an empathetic view of fellow humans (Verschueren and Koomen, 2012). A robot teacher is not going to have the social understanding to be able to perform such functions, and even if it did, it surely would not be a good idea for children to model themselves on robots, however lifelike they were.

Robots in the classroom may be able to function as educational tools: for instance offering the opportunity for the individualised practice of skills such as speaking a foreign language. At the same time, we need to guard against using them too much or imagining that they could replace skilled human teachers.

The very idea of developing and using robots for teaching could be viewed positive evidence of the crucial role that teaching plays in the development and maintenance of human culture. It could also be seen as an unhappy development that moves us further away from the evolutionary roots of

teaching behaviour in humans towards a scenario in which teaching is automated and outsourced to machines.

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