‘New Intelligent Robots Offer an Expanding Educational Role’

Computers first appeared in schools in the early eighties. So did robots. Whereas we average between 5 and 10 students per computer, the uptake in robots is not surprisingly significantly lower. In a series of 3 articles Dave Catlin, designer of the Valiant Turtle and Roamer®, thinks in the next few years we will see increasing numbers of robots starting school.

I first met the ideas of MIT's Professor Seymour Papert in 1982. Papert had the spectacular notion that we should teach children to “think”. This had not been part of my education and from my practical experience as an engineer it was an idea I totally endorsed. Yes, I know a lot of maths, science and technology, but without “thinking” this is simply trivia.

Robots are evolving and will soon be a teaching aid we use everyday. Valiant's educational robots have evolved from the Turtle to Roamer and now Roamer-Too, which embodies many modern robotic technologies.

Papert asked an insightful question: “Do we want children to program computers or computers to program children”. As an ex-colleague of Piaget, Papert was a committed constructivist. He believed students are active learners who do better constructing their own knowledge, rather than passively absorbing information through traditional teaching methods. In a stroke of genius he combined ideas of Artificial Intelligence and Piaget's developmental theory into a powerful tool: a computer language for children called Logo. Using Logo students program a virtual creature called a Turtle to move forward and turn. From these simple commands they develop powerful mental models and ways of thinking.

Studies show that young children prefer activities involving physical interaction [1]. Papert quickly realised the need for a physical robot living in the same space as the students. He called this “an object to think with”.

> *“Children can identify with the Turtle and are thus able to bring their knowledge about their bodies and how they move into the work of learning formal geometry” [2].*

Papert's idea of “playing Turtle”, using your body to think with, was ahead of its time. As the student walked around they saw the world from the Turtle's perspective. It seems clear from subsequent research in cognitive and neuro science that our perception of the world is strongly linked to our physical existence in it.

In 1989 Valiant Technology launched the Roamer®, which put a version of Logo into a microprocessor on-board the robot. Suddenly the computer was not this remote device you programmed to control a "disembodied" robot, it was what made the robot "tick"; you programmed it directly. Within a year of Roamer® appearing Duncan Loutitt of Swallow Systems launched Pip, an alternative design that did pretty much the same thing. In 1995 Louttit launched Pixie. This replaced the standard Logo commands move and turn an amount specified by a number with a counting paradigm. To move Pixie forward 3, you would press the forward button 3 times.

'More Robots set to start school' predicts Dave Catlin.

Pixie lifted robots from the floor to the desktop. This sadly diminished the value of "playing Turtle", particularly since Pixie was aimed at younger children where the body geometry principle was most effective. This said the move had clear and appealing classroom management advantages. The recent success of BeBot, essentially a copy of Loutitt's idea backed by a stronger commercial organisation, proves this point.

In the late eighties and early nineties Lego dabbled in control and produced Lego Turtle kits supported by Lego Logo. However, they had a bigger vision and asked Papert to design an intelligent brick. This led to the launch of Lego Mindstorms in 1999, which still reflects constructivist philosophy, but starts with building the robot, thus extending the general idea into older age groups. Very broadly: Roamer® type devices focus on using technology to educate and Lego robots orientate towards teaching technology.

Kaspar a robot developed at the University of Hertfordshire is used as a therapeutic tool for use with autistic students [3]. The idea is that the robot will be a mediator for human contact. Development team member Dr. Robins said "We are seeing already that through interacting with the robot, children who would not normally mix are becoming interested in getting involved with other children and humans in general and we believe that this work could pave the way for having robots in the classroom and in homes to facilitate this interaction

Despite the invention of Logo in America its adoption by the US education system, which was strongly influenced by behaviourist principles, was patchy. In contrast the UK had been absorbing Piagetian ideas for over a decade. Logo appeared as an exciting way of achieving the goals already clear in the minds of many educators. Consequently, the use of Logo and robots became standard. However, my experience shows the true potential of such devices is largely missed. In many schools Roamer® is scheduled into the timetable "when we are doing control". This is in sharp contrast to the perspective once expressed by Helen Logan (ex Bradford ICT Advisor):

"I like Roamer® because it helps me teach difficult concepts; children like it because it is fun."

In 2002 I visited Papert in his Maine home. We discussed this problem. He expressed some regret at how the restrictions of school life had partially stifled his innovations. However, he was optimistic in the potential for robots to serve as epistemological devices that would help students acquire clear ideas across a range of subjects. I agree with him. I believe advances in robot technology and our understanding on their educational potential has grown exponentially.

Pebbles above developed by Telebotics at the University of Ryerson, Toronto goes to school as a surrogate for bed-ridden students [4]. Ellen Bergman District Superintendent of the Mount Pleasant Hospital School in New York summarises its value: "Students soon see beyond the technology and relate to Pebbles as if it was their classmate. The bed-bound patient is even able to socialise. We had one girl play cards with her friends and attend the school concert. The effect on the student's rehabilitation is remarkable.

We are starting to see a range of robots emerging from different historical paths than from those that followed Papert's thinking. Some of these have the label "educational" attached to them, though I have to admit as someone steeped in the Papert tradition I find it hard to see anything that exciting. Others like Kaspar and Pebbles show great promise.

Robots like Roamer®, Pip, Pixie, BeBot and ProBot are really very dumb. They are useful because students provide the intelligence. General improvements in hardware technology now allow us to add Artificial Intelligence into the robots at a reasonable price. This provides the more dynamic and exciting possibility of students interacting with "intelligent machines".

However, it is not about the technology, but the educational ideas. The strength of Roamer® lay in Papert's theories. For the last decade I have been looking at how to extend Papert's thinking to embrace the new possibilities. Valiant have been encapsulating this in Roamer-Too™, their new robot scheduled for production by the end of the year.

In the next article I will explore the value of robots in technology education. The final article will look at innovations that will revolutionise the way we use robots in educational technology.

[1] Greenfield P.M. (1984) Mind and Media, Cambridge MA: Harvard University Press.
[2] Papert, S. (1980) p 56 Mindstorms, Basic Books.
[3] http://kaspar.feis.herts.ac.uk
[4] http://www.ryerson.ca/pebbles