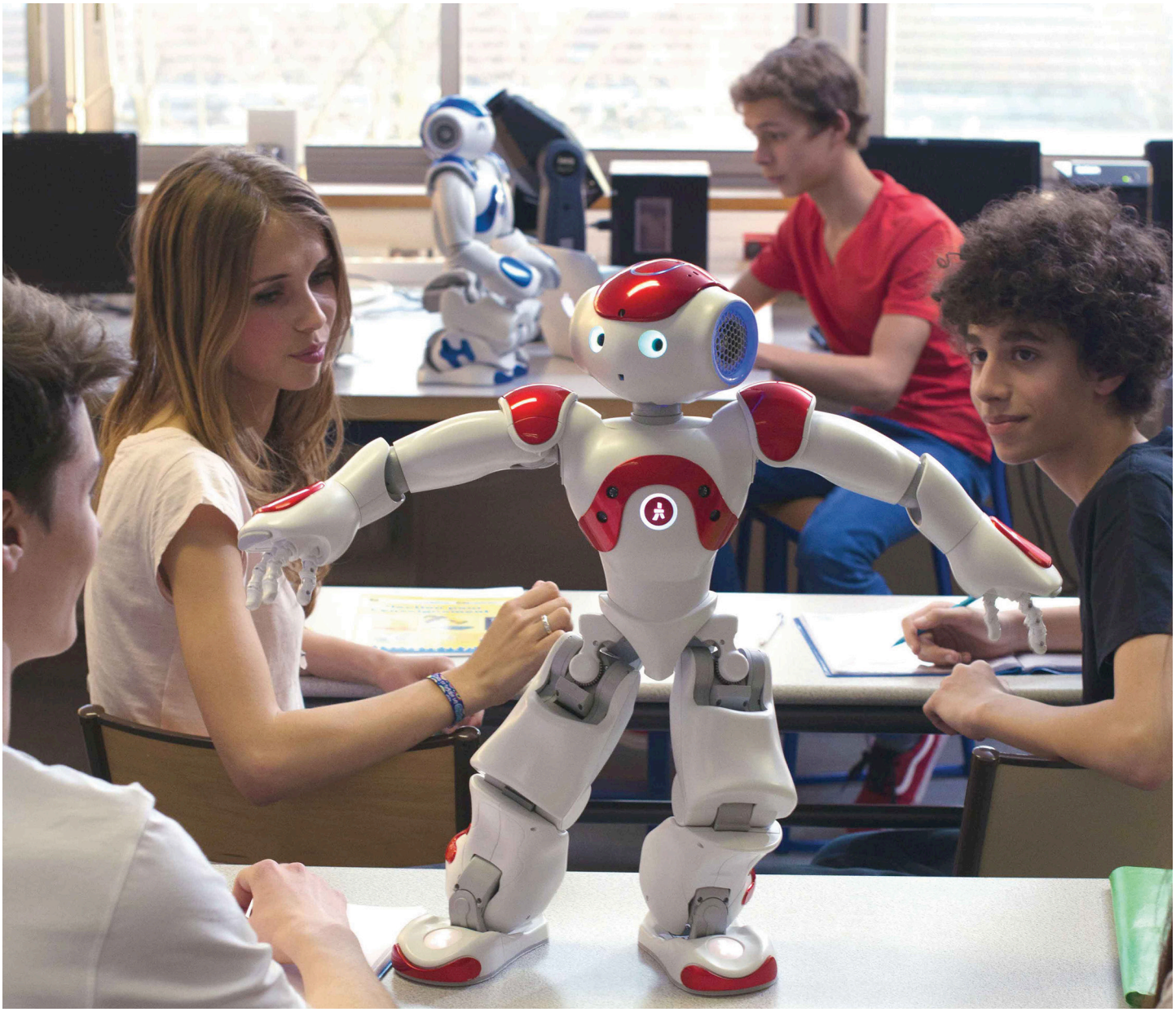
NAO robots enhance learning in SA

ET Staff



Eighteen months ago, NAOs arrived in classes in the South Australian Independent Schools network. The programmable robots that talk, dance and even speak German were expected to be a lively new addition to the school environment, but more than that the robots have proved to be a cipher for high level, innovative learning.

From day one, the addition of NAOs to learning at schools in the network has been the subject of study, coordinated by the Association of Independent Schools of SA (AISSA), Swinburne University, Queensland University of Technology and Queensland University, who suspected that the robot would realise a powerful new aspect to education at the participating schools.

To date, those suspicions have been proven correct; the NAO robots have unlocked innovative approaches to education, a collaborative facet to the way that students and teachers interact and learn together, rapid uptake of high level cognitive processes as well as a remarkably quick adoption and learning of industry standard coding language Python by some students.

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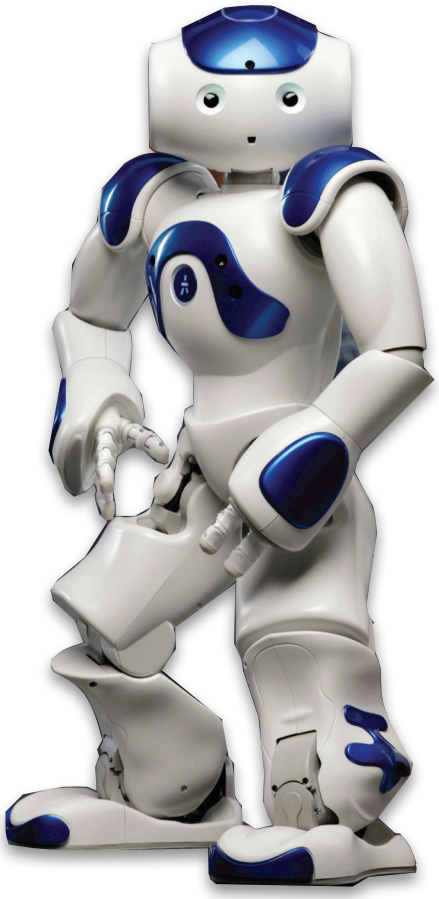
Monica Williams, a researcher from the AISSA says that both teachers



and students were as intrigued and curious as each other when presented with the two-foot-tall NAOs and therein began the shared experience of exploring what and how the robot worked and what it could do.

While there has been a lot of research into the effects of humanoid robots in the areas of autism and brain injury therapy – they've proven to be very effective in both fields – this is the first major study nationally of how humanoid robots affect learning and teaching within schools.

Seven schools have been involved in the research so far with Williams expecting that once the research has concluded around 15 schools will have been included.

"This is a multiple case study approach. The AISSA bought the robots from The Brainary in Victoria and entered into a partnership in that we are sharing all the data we've gathered between the AISSA and the universities involved. We intend to present our findings at conferences and we will be writing papers for publication in peer reviewed journals. There is intellectual rigour in the way the research is being conducted," Williams says.

The research has been conducted across learning areas and across year levels, the robots have been used with students as young as four years of age in an early learning centre up to Year 10. They've been used in a number of learning areas from Maths and Digital Technologies, English and in German language classes as one of the robots speaks German, in a primary and secondary context.

Yet another surprise is the effect that the robots have had on the way students and teachers interact when using them

The main focus has been on the new digital technologies curriculum and Williams says that the robots' involvement has made the new curriculum much more accessible.

"The results have indicated that the robots really energise teachers and school leaders to embrace the new digital technologies curriculum. The sophistication and depth of student learning has far surpassed our expectations.

"The new Australian Curriculum Digital Technologies subject was only introduced last year for full implementation in 2016/2017, the NAO robots have been a very powerful way to energise schools toward implementing the new curriculum.

"There has been remarkable evidence of higher order thinking skills in students and one of the questions we now have is whether this significant learning trajectory will continue when teachers and students have access for longer times as, mostly, the schools have the robot between eight and 10 weeks," she says.

The other question the researchers have come up with is to what extent are the skills learned transferrable? The students are doing very sophisticated things within the digital technologies curriculum and whether those skills are transferrable to Maths, Science, English and other STEM subjects is to be investigated.

Yet another surprise is the effect that the robots have had on the way students and teachers interact when using them.

"Teachers will, for instance, know about narrative writing and will have since the beginning of their own education. If they are presented with a humanoid robot, chances are they will not know about robots so it makes the learning environment a much more collaborative one.

"The teachers' pedagogies change because the whole class is learning together, the teachers of course have specialist training and ongoing support from the AISSA but when they're in the classroom everyone is learning together. That means the learning environment is more creative and collaborative which has had a significant impact on how the students see themselves as learners and has given them much more agency," Williams says.

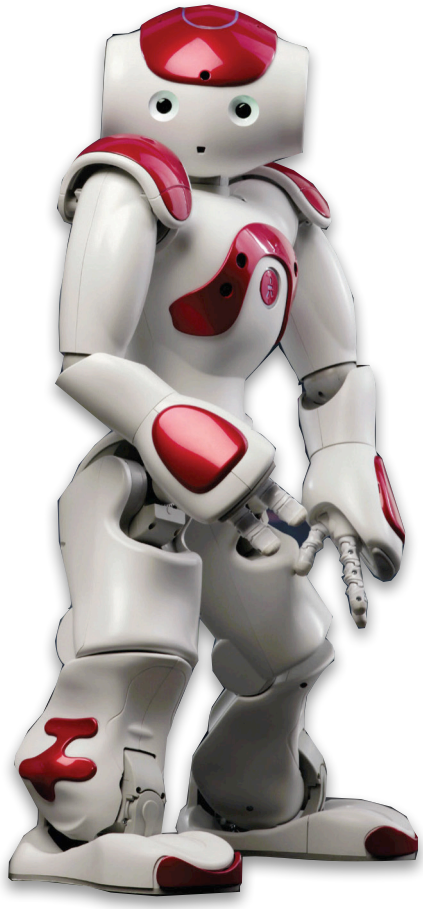
Remarkable things have come from that sense of student empowerment, students as young as 11 have demonstrated they have been involved in self-teaching Python (a coding language) which is widely used in industry. That has happened on a number of occasions and all within the short eight weeks that the NAO robots have been present in classrooms.

"It leads teachers to not only think about what is happening in their classrooms but encourages them to start thinking about mapping it across the whole school, evidence seems to indicate that engaging with the robots changes the way teachers think about the curriculum, and even when the robot goes, things at a number of the schools seem to happen differently because they have had that experience," Williams says.

The early indications have been encouraging and the researchers are interested to see whether these effects continue on with wider involvement of the robots across more schools, whether the remarkable effects observed to date continue on with longer exposure to the NAO robots or whether effect plateaus or tails off. Toward that, two schools in semester two will have the robots for five months.

"That will give us information about what happens when the schools have the robots for a longer period of time which will inform our decision about how to proceed with the program in 2017," Williams says.

Each of the robots comes with 30 floating licences so every student in class can be working on the virtual robot. Students use the software on the virtual robot on their laptops and then take turns to try what they have written on the physical NAO.



"It's a really easy way of engaging the whole class, and two schools have bought their own robots after being involved in the project. Schools then purchase a licence for the whole school. The licences aren't restricted to school based use so students are able to use the software at home.

"There is a lot of opportunity for the students to be critical and creative thinkers and to work at their own speed. Because there are many entry points for engaging with the robots, students can work at their own level; the coding can happen via drag and drop or students can access the manual interface and actually create a new dance for the robot, programming the movement and inserting a soundtrack," Williams says.

The level of understanding shown has been remarkable; students as young as Year Three have been able access the high level functions of the robot. More remarkable still, four-year-olds in an early learning centre were given pieces of paper and asked how Thomas (the robot) was able to understand messages. They were able to conceptualise that coded messages were being sent from the laptop to the robot, some represented it as messages, some represented it as dots and circles.

"What surprised the director was the depth of the students' understanding and that once the teachers opened up to working with the students on the robot they continually saw things that surprised all of us as to what students were capable of," Williams says.

None of the teachers have reported a difference in engagement between male students and female students across all of the year levels which is interesting in itself as more boys tend to gravitate toward STEM subjects than girls.

In fact some of the most remarkable examples of students taking the ball and running with it with regards to programming the robots have been produced by females.

One of the schools' Year Nine students wanted to devise a program in German for the Year Eight students to teach the vocabulary around body parts. A Year Nine girl taught herself Python so she could get the robot to ask "what is this?" in German and collaborated with two other students who programmed the movement using a timeline to get the robot to indicate a body part by pointing to it.

"The person was given two chances to answer correctly using the correct German pronoun and if they weren't able to the robot would provide the correct answer and move on. In their own time they were able to create a program which could be used in the lower year, I asked the girl who undertook the task how long it took her to learn and write the eight scripts that were required in the program and she answered 'oh, about 20 minutes'".

"All of the students both male and female, as well as the teachers tend to form a relationship with the robot because of the endearing way it behaves. Everyone tends to engage with it in a deeper way than you would with say a laptop or a washing machine.

"All of the evidence indicates that the relationship with the robot has an effect on the level of engagement with the robot and the willingness to persist, there are constant glitches when programming the robots but the personification of the robots means that there is a framework of tolerance that doesn't exist with say a car or a laptop" Williams says.

"I have video of students playing with the robot trying to make it move, trying to slow down the speech and discovering how to do it through play, and it is in the area of play it seems, where the deepest learning occurs."

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More humane than human – NAO robots in therapy and teaching

The hardest thing about getting through to a child with autism is not over stimulating them while trying to interact.

We forget how much is actually going on when we talk to one another, there's facial expressions to be decoded, body language, tone and volume of voice, smell, colour, movement… and when you're autistic, it's like everything is being dialled up to a level where it's overwhelming and scary, so you retreat.

For those outside of the autism spectrum, dealing with the myriad components of conversation is natural and kind of fun, not so much with sufferers of the condition. The best way to address the autistic is with slow, modulated speech, which often doesn't come naturally, so imagine how useful it would be if there was a switch that you could use to turn the amount of stuff that's going on up or down.

Enter the NAO robot, which is distributed in Australia through The Brainary in Geelong Victoria, the friendly little guy has the advantage of being programmable so it's as human- or robot-like as you wish and there's a body of evidence and research around its use in helping autistic children to open up and improve their speech and ability to cope with others.

Programmable robots have applications in both the treatment and the diagnosis of autism. NAO has been used to treat the condition through imitation of gestures made by the NAO, the ability to imitate indicates the level of the child's autism and enhances their ability to perform basic tasks and integrate overall. Research has shown that the subjects responded better to the robots than to humans and point an important therapeutic role for the robots in treating the disorder.

NAO robots have been used to great effect in diagnosing autism by observing performance on a series of tasks; calling the child by name, noticing the level of eye engagement, functional and symbolic play and noting a child's ability to communicate through more than one channel at a time.

Jonathan Kingsley from The Brainary says that there are any number of applications that the robots can fulfil and that they've also proved very effective in physical and acquired brain injury rehabilitation.

Therapy aside there's very wide application for the robots, Kingsley has seen them do everything from perform in a chorus line to being programmed to make the teacher a coffee as well as assist in the teaching of programming and languages (see main stories).

"We run introductory packages and within a day we can get students programming their own behaviours and designing their own apps, I would say that really within half a day you can see some really advanced robotics happening," Kingsley says.

The Brainary also run robot incursions in partnership with Swinburne University where undergraduate students visit schools and help students to explore the robots' capbilities.

"The thing about the robots is that they're so engaging, they're really designed as social robots, if you compare it to something like Lego or (drag and drop programming interface) Scratch, where the robot comes into their own is in their social aspect, they're really cute and in that way they're a really powerful learning transfer," Kingsley says.