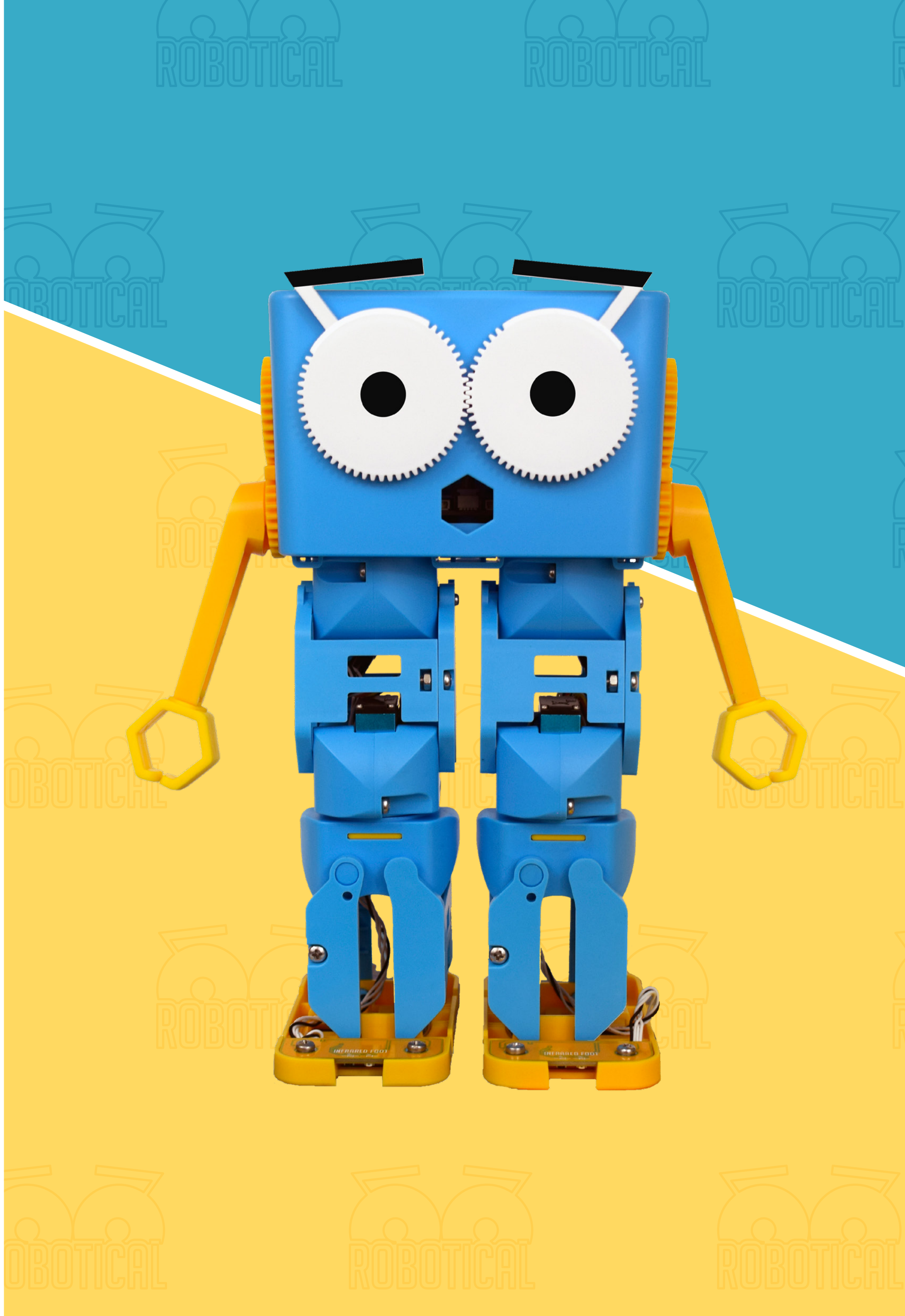
ROBOTICAL

THE BENEFITS OF USING HUMANOID ROBOTS IN EDUCATION

EXECUTIVE SUMMARY

Humanoid robots are characterised by their human form and behaviour. As they have grown increasingly prevalent in today's world, humanoids have been used to perform roles in retail, hospitality and education.

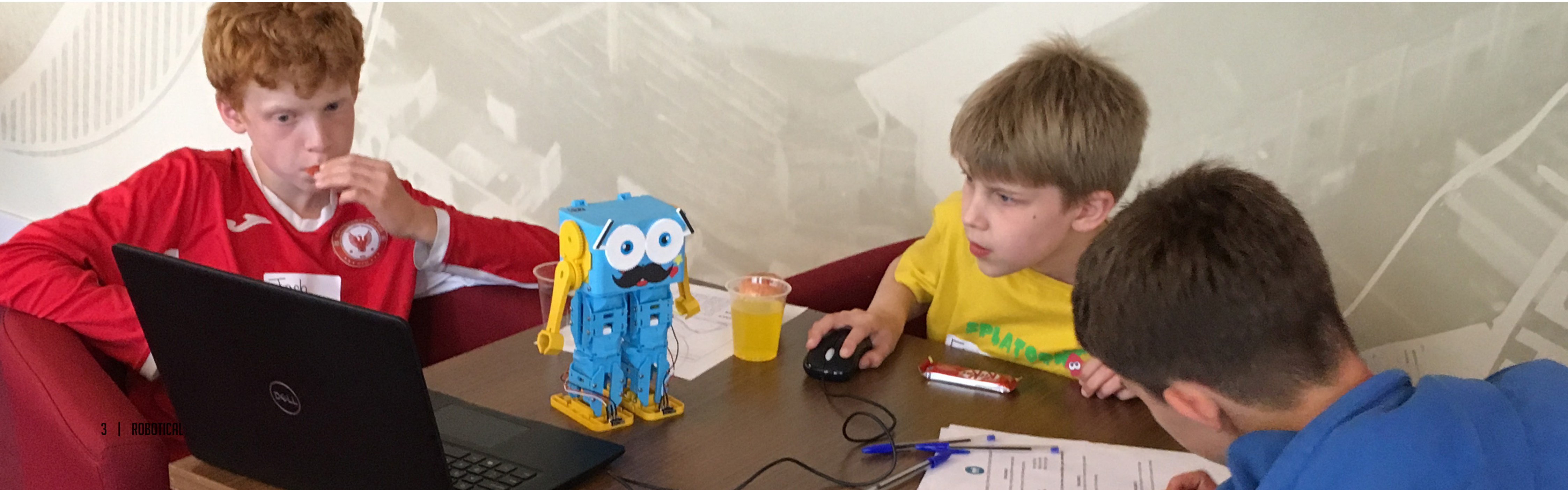
In education specifically, there are several areas where humanoid robots have been found to support learning and engagement. They have been shown to help develop computational thinking in young learners and foster greater engagement from pupils across a wide array of subjects in the curriculum. Humanoid robots are a wonderful educational aid in teaching children on the autistic spectrum. Having a human form has been proven to invoke a stronger connection and a sense of ownership in the students, and this has been especially effective using 'learning by teaching' and care-giving educational styles.



COMPUTATIONAL THINKING

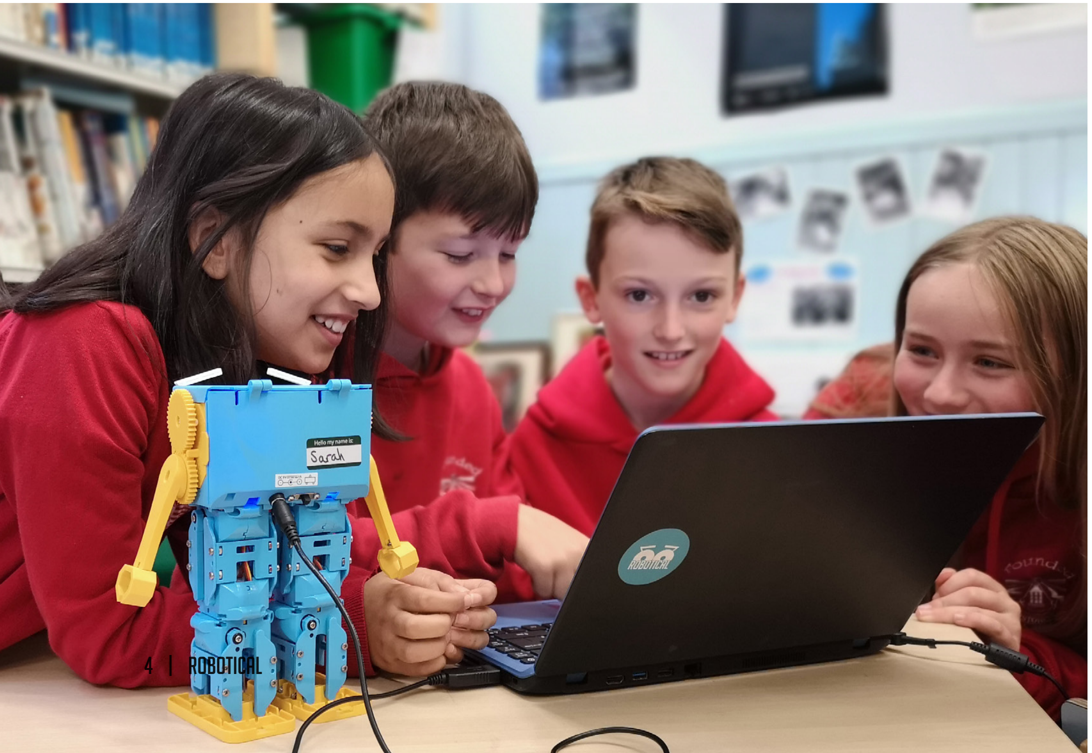
Humanoid robots are being increasingly used to teach computational thinking in classrooms around the world (Pandey, 2017). Computational thinking is a fundamental skill that every human needs in order to function in modern society, whether they are a computer scientist or not (Wing, 2006). It is a way of conceptualizing problems and thinking of them at multiple levels of abstraction. It does not involve getting humans to think like computers, but instead focuses on using creative and clever thinking to solve problems with the aid of computers. Computer science draws on logic, mathematical thinking and engineering principles to take ideas and have machines realise them efficiently. Thus, computational thinking is for everyone, everywhere.

Whilst computational thinking permeates every aspect of our lives, it is most prevalent in the STEM subjects; science, technology, engineering and maths. Robotics and robots provide an interactive and innovative platform to teach STEM subjects, programming and logic to pupils who may otherwise be hard to engage (Softbank Robotics, 2019). However, whilst robots provide a fun and exciting way to teach computational thinking it is important that educators have instructions on how best to use robots in their lessons as the task can appear daunting to those who are less experienced (Chevalier, 2020).



ENHANCED ENGAGEMENT

Humanoid robots have the ability to carry out human-like social signals, and body language, which has been shown to foster greater engagement with pupils (Alcorn, 2019). The physical interaction this offers draws on the curiosity of students, motivating them to learn by capturing their interest and holding their attention. In the context of learning new words, children were found to strongly prefer learning with a robot (rather than a tablet), which they perceived as being like a human (Westlund, 2015). The presence of a humanoid therefore allows students to learn technical subjects that may otherwise be quite dry in a fun and dynamic way.



AN AUTISTIC TEACHING AID

Autistic children are often interested in, and motivated by, robots. This is thought to be because they are interactive yet programmable and rule-based devices (Straten, 2019; Rudovic, 2017). In addition, the technical aspect of robotics is thought to motivate and engage autistic learners more than adult educators alone can (Rubins, 2006). However not all robots engage autistic individuals equally. A humanized body appearance has been shown to generate a higher degree of interest in the interaction than a mechanical (wheeled) appearance, and a 'voice' with intonation matching the appearance of the robot triggers a higher degree of happiness in children with autism (Straten, 2018).

Research has shown that educators consider human-ness as being pedagogically important (Alcorn, 2019). Humanoids have also been used as an aid to offer robot-enhanced therapy for the special education of children with autism spectrum disorder (ASD) in a European study. During these studies the robots assisted the therapist in teaching autistic children social interaction skills such as turn-taking when playing games (Esteban, 2017).

Humanoid robots can therefore provide a unique bridge between engaging students with a highly technical, predictable device and fostering human-human interactions.

NURTURING STRUGGLING STUDENTS

Students have been shown to perceive robots as being less judgemental than teachers, and as such are more willing to make mistakes in front of them than in front of teachers or peers. This allows for greater engagement, especially amongst struggling students, and helps build confidence. In addition, the predictable nature of robots makes them appear understandable and non-threatening to students, supporting learning (Pandey, 2017).

THE 'HUMAN FACTOR'

Unlike other robots, humanoid robots offer numerous advantages in the educational environment. Children often consider humanoids to be a social person and feel deeply attached to them. Their affinity for humanoid robots is further increased if the robot moves in a human-like fashion, as opposed to being wheeled (Mori, 2012). This connection with humanoids leads to children taking ownership of them, which in turn aids concentration in the educational environment (Han, 2008). Studies have shown that children and teenagers often commit and invest more in a task when they are teaching a teachable agent as opposed to learning for themselves (Jamet, 2018). In the context of learning vocabulary, students strongly prefer learning new words using a humanoid robot rather than a tablet (Westlund, 2018). During interaction with teachable agents such as robots, social attitudes, including a sense of responsibility, motivate students to work harder, increasing their understanding. Furthermore, the presence of robots in the classroom has been shown to provide motivation and a positive attitude (Lin, 2009).

CROSS CURRICULAR LINKS

Humanoid robots can be used to successfully teach a wide range of subjects including reading, writing, languages, science, technology, engineering and mathematics. However, they have also been used to teach metacognitive abilities, such as self confidence, motivation and task-commitment in students of all ages, with and without special educational needs (Chase, 2009; Lemaignan, 2016). These skills are essential for learning to be efficient and effective, especially in those students who have additional educational needs. Another area in which humanoids are often used is teaching second languages to learners (Chang, 2010).

LEARNING BY TEACHING

A humanoid form makes robots appealing to people of all ages and a perfect companion for students to learn by teaching, for example, by programming a robot to perform dance moves. Humanoid robots have used the ‘learning by teaching’ style to teach children to read, write and reason (Masson, 2016; Jamet, 2018). Robots with a friendly appearance and ability to perform precise movements allow children to relate to them on a deeper level, motivating increased interaction and the learning of new skills in the process. Robots that can walk and mimic human movements literally bring learning to life by mimicking human gestures and social cues. Their interaction with small objects such as kicking a football, and making gestures such as waving, provides an additional layer of interest to learners (Straten, 2018).

Humanoid care-receiving robots have also been used to motivate learning. They use the innate caretaking and caregiving behaviours of children to elicit learning (Tanaka, 2007). By presenting themselves as a fragile being that needs to be cared for, humanoids can encourage students to invest time and effort into reading aloud to them or performing other educational activities. Another teaching framework unique to humanoids is the total physical response framework, used to teach second languages. This involves learners performing actions relating to the words they are learning; such as simulating kicking a football, when learning phrases such as “scoring a goal” (Asher, 1969; Tanaka, 2015; Jamet, 2018).

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