Kylie Burrett is the teacher librarian at Whitebridge High School, located in the Hunter region of NSW. In her article she shares how a lunchtime robotics and coding club has helped students to develop essential 21st century skills and engage authentically with technology.

**Introduction**

Robotics involves a seamless mix of theoretical and practical experiences to enable learning by doing. Teaching coding and robotics in schools is developing momentum and is now seen by many educators and industry leaders as a powerful way to develop critical thinking and information and communication technology (ICT) skills. The Imagineering faculty, which is part of the Technology and Applied Studies at Whitebridge HS, is working collaboratively with library staff to promote student interest in science, technology, engineering and maths (STEM) education and the integration of 21st century learning by developing a robotics and coding club. The club aims to help students develop their robotics and coding...
skills, connect with peers and mentors and explore pathways to higher learning and career opportunities.

**Background**

Whitebridge High School is a co-educational, comprehensive high school located within the city of greater Newcastle in NSW. Of the 1056 students in Years 7–12, four percent identify as Aboriginal and five percent are from language backgrounds other than English. The school strives for continual improvement and provides a broad, balanced and relevant curriculum.

In 2013 the Imagineering faculty, ran a series of student led engineering Challenge Days, focusing on creative thinking and ICT skills. The program targeted all students in years 7–10, as well as selected gifted and talented students (GATS) from partner primary schools. Approximately 20 teachers and 10 local businesses collaborated to generate the challenges and support this STEM initiative. The challenges were designed to motivate and encourage students to develop an interest and love of design and innovation. The program was highly successful and has since become a regular event in the school calendar.

This year, as part of the initiative, a robotics and coding enrichment program for Yr 5 students from surrounding primary schools was held in our school library (The Hive). During the session students actively engaged in constructing LEGO® robots and coding them to perform several tasks. What stood out most was the level of engagement. These students were no longer passive targets of learning. Instead, they were active innovative learners, helping each other with each new discovery.

Reflecting on this amazing workshop, it was very clear that students at Whitebridge could also benefit from access to robotics and coding experiences in The Hive. Before the program began, students in Years 7 and 8 were only given a brief introduction to robotics and coding through Technology (Mandatory) at school. Looking for ideas, to increase student exposure to the disciplines of technology and computer science, the idea of an online coding and robotics club was attractive. However, some expertise was needed. The Imagineering faculty was approached and asked if they would collaborate with library staff to develop a robotics and coding Club (RoboHive). When they agreed, it was very exciting. As well as benefits for students, it was a wonderful professional development opportunity to develop a learning space within The Hive that was accessible to everyone, regardless of their formal subject selection.

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The inspiration for Whitebridge's RoboHive: Year 5 students from primary schools around Whitebridge HS attending a coding and robotics enrichment program in The Hive.
Why create a robotics and coding learning space?

STEM is everywhere. Our nourishment, our safety, our homes and neighbourhoods, our relationships with family and friends, our health, our jobs, our leisure are all profoundly shaped by technological innovation and the discoveries of science.

Australia’s Chief Scientist 2013

Staff at Whitebridge HS are striving to create a 21st century learning culture. What was once a traditional library is now a central, vibrant and diverse learning commons, called The Hive. This change reflected a global shift towards 21st century learning outcomes. As part of these changes more community connected learning spaces are emerging. In schools and libraries these spaces are often referred to as makerspaces or hack labs. Globally, these informal, inquiry based platforms, workshops and clubs are encouraging students to collaborate, develop computational thinking, test theories and play to learn.

Links to the curriculum

The Australian Curriculum’s focus on inquiry skills reinforces the importance of creating inquiry opportunities for student driven learning. Lupton, (2012) emphasises a teacher librarian’s bird’s eye view of the Australian Curriculum, which helps makes them vital partners in implementing and supporting emerging technology trends and inquiry based pedagogy.

The inclusion of Information and communication technology capability and Critical and creative thinking as general capabilities within the Australian Curriculum (2014) demonstrates the significance of developing these skill sets for 21st century learners. Australian Curriculum, Assessment and Reporting Authority (ACARA) advocates that educators need to identify and provide students with additional opportunities to learn and participate in evolving technologies. Highlighted within the...
Students participating in the club are provided with multiple opportunities to extend their inquiry, ICT and critical and creative thinking skills. The club’s focus on digital technologies and computational thinking links directly to the Australian Curriculum’s [key ideas](#) for Technologies subjects.

### Getting started

To assess student interest before starting the club, two robotics battle sessions were held, showcasing the LEGO® EV3 systems.

These sessions were held at lunch in The Hive and were open to all students. News of the impending battle spread amongst the students. The atmosphere during the robotics battles was electric. The robots whizzed and spun, searching for their opponent. Once they located the rival robot they charged towards each other, trying to knock their opponent out of the ring. The cheering was deafening and it was very clear that there was a lot of interest.

To get started, LEGO® was chosen as it forms part of popular culture. In fact, Cendrowicz (2008) estimates LEGO® is so popular that there are 62 bricks for every person on earth. Garcia (2014) suggests that by integrating digital interests with peer culture learning experiences can be forged that help youth develop the ability to adapt and thrive in a 21st century context. For the club to work effectively, a fun element was needed, and LEGO® provided that hook. The LEGO® EV3 robots are programmed using a visual language where blocks are dragged and dropped into place. A beginner student is programming and downloading within 10 minutes of instruction. It really is that easy to get students started. Additionally, LEGO®’s simple visual drop and drag interface is suitable for a range of learners, including GATS and students with learning disabilities.

NSW syllabuses for the Australian curriculum in their advice on programming is the importance of including a range of ICT tools and resources to support learning. These include:

- multimedia creation tools
- game based learning opportunities
- online collaboration tools
- web 2.0 and 3.0 tools
- contextualised learning experiences including robotics, virtual learning environments and web quests.

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**Key ideas and relationships in Australian Curriculum Technologies**

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**Example of a LEGO® Mindstorms project interface**
Beyond LEGO®, learners will be able to explore diverse challenges and real world implementation of Arduino robotics. To realise this next step a permanent hack-lab for the club is being created, where students can extend their learning by creating robot parts on a 3D printer and control them using an electronic Arduino board. Students will learn to write code in a simple version of C++ called Arduino IDE. These coding skills will enable students to program the electronic control systems used in the real world. One application being discussed with teachers is to collaborate with the schools electric bike program; which uses an Arduino based control system.

Importantly, the club aims to immerse students in a peer supported environment. Ito et al. (2013, p.62) suggests that academic opportunities in a peer supported framework will help students flourish and move towards their potential. Similar to the engineering Challenge Days, students are encouraged to lead discussions and participate in peer mentoring. Intuitively the students seem to know how to help each other and respond to other members of the club in a timely manner. The Imagineering teacher or the teacher librarian supervise, offer guidance and are responsible for managing the required equipment.

Integrating learning tools
More recently, a Google Classroom has been created to provide an online environment where students can chat, develop resources, share designs and work on coding/programming solutions. Hopefully, this virtual option will give the less confident students the opportunity to interact and investigate remotely, making it easier to lurk in the background and develop confidence.

One measure of success, is the increase in the number of students, selecting technology electives. David Kelly, head teacher of the Imagineering faculty said, "The interest from year 7 selecting year 8 subjects has been overwhelming."

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Our numbers are growing and we are introducing extra elective classes to cater.

It will also be interesting to see how students generalize their learning across the curriculum.

What next?
Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It’s intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. www.arduino.cc

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Until now the code has been written by a parent. Next year, students from the club aim to write the code. These bikes are designed and built by students and are raced annually as part of the Hunter Valley Electric Bike Festival.

Critically, retaining of girls in the club is an ongoing issue. By creating a conceptual design for a user friendly connected learning platform, it is hoped that the club can develop an online platform that will appeal to a wider audience, and promote broader opportunities like Robogals, an international non-profit organisation that promotes female participation in engineering.

References and further reading


