

Immersive and hands-on, the learning experience ignites students' curiosity, inspires their creativity and nurtures their computational skills.

# Robotics and coding learning at CDNIS equips students with future-readiness

Many people call the times we are living in the digital age. From iPhones to smart watches to now, even robots.

Since 2016, students at Canadian International School of Hong Kong have already been building working robots and proving they can adapt to the digital era.

Vivian Fung, a robotics and coding teacher at CDNIS, says when the school first introduced the robotics programme in 2016, students took to it right away, and two years later the school rolled out its 1:1 robotics programme. What sets the CDNIS programme apart from other robotic lessons where students just learn coding principles is that CDNIS ensures the robots are used in an engaging way to illustrate mathematics and other concepts as well.

"The goal of the CDNIS Robotics Programme is to develop students' competencies around computational thinking and nurture creativity," says Fung. "From the very beginning, students were keen to take part and learn. Some students designed their robots to run an obstacle course, while others designed a robot soccer game which included ultrasonic sensors to keep score automatically."

In the classroom, students as young as Grade 3 take part in the 1:1 Robotics Programme and assemble their individual robots from start to finish. This hands-on experience allows the students to understand how things work. Throughout the year, the robots must perform various tasks including displaying light patterns, facing off against other robots in a sumo match, and even including the use of a robotic arm. Following each task, students refer back to the Design Cycle as they inquire, plan, build, test and evaluate their robot design each step of the way, which results in a more innovative and intuitive robot with each iteration.

Not only are the students' robots put to the test against those of their peers but also against other robots designed by students in the Greater Bay Area. In 2019, CDNIS was the host site for the international school section of the MakeX regional competition. And while robots of today are predominantly used for handling items – including packaging, picking and placing – the MakeX competition pushes students to design robots for other uses.

"The MakeX competition is more about just building a robot and that is why we participate and support the event. The competition promotes solving authentic environmental problems through innovation, which means students learn about the sustainable development goals and build robots which could one day be tasked with solving environmental issues," Fung says.

Because of a desire to broaden its students' robotics knowledge further, CDNIS set its sights on expanding its programme by taking it off the obstacle course and into the swimming pool.

"We learned about an underwater robotics programme several years ago. But when we tried to enroll our students, spaces were few, so we set out to create our own programme," Fung said.

The school contacted the Institute of Electrical and Electronics Engineers (IEEE) and together with members of CityU's Remotely Operated Underwater Vehicle team, better known as ROV, held its first underwater robotics workshop where students built underwater robots using PVC pipes. A short time later, the school sent five teams to the Hong Kong Regional MATE ROV competition, with teams taking home the Best Engineering, Best Manager and Best Team Assistant prizes.

CDNIS' strong showing at the event led to further collaboration with CityU's ROV team who, in conjunction with UCode and CDNIS, offered an intensive two-week workshop this past summer in which students studied everything they could about CityU's ROV sophisticated capsule underwater robot. Throughout the process, students learned different STEM skills such as soldering, circuit wiring, buoyancy force and CAD drawing as well



as coding to control the underwater robot.

CDNIS' Underwater Robotics Programme went beyond just building a working robot. While many of the students already had experience building a robot that could move on wheels, walk and even jump, none of them had built a robot that could swim before, let alone navigate an underwater obstacle course which their robot was tasked to do on the final few days of the programme.

The students tested out their robots by dropping them into the pool and navigating them from the water's edge. The robots glided, then dipped underneath the water, then practiced doing figure eights as they were made to swim to the bottom of the pool. Once there, the robots collected and moved objects; entered, turned around and exited through narrow passageways; and moved from one side of the pool to the other before swimming back up to the surface.

"Our students were fortunate to work so closely with CityU's ROV team," Fung added. "The knowledge they gained was second-to-none."

Many of the students who participated in the summer programme are applying what they learned as they build their robots for two upcoming competitions - the MATE ROV competition, which takes place at the end of October and the MakeX in March. The MATE ROV robots will include a camera, sensors and tooling, as if made to support inspecting and repairing damaged cables and buoyancy modules on offshore wind turbines. As for the MakeX competition, the theme is Zero Carbon. So as students build their robots,

they will also learn about various aspects of managing carbon emissions including the use of renewable resources and automatic irrigation systems.

"The overall objective of teaching robotics is to ignite students' curiosity and motivate them to explore and understand how things work," Fung added. "The fact that students are engaged in their learning and having fun at the same time is why our programme is so successful."

