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Teaching computing

Robot Clubs at Crofton Hammond Junior School

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I work with Year 6, running Robot Clubs in several schools and find that robots can be used in a fun and challenging environment to cover many aspects of the new computing national curriculum, in particular controlling and simulating physical systems.

Here's what the National Curriculum in England Key Stage 2 computing programme of study (September 2013) says: "Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts."

I run afterschool clubs at Harrison Primary, Whiteley Primary and Alverstoke Junior, lunchtime clubs at Crofton Hammond Junior, and I have day workshops planned in other schools. Nearly 60 children take part, but disappointingly only six girls have taken part, so currently I am working on more female-orientated tasks.

I run my clubs with the ratio of one robot to two or three children maximum. You cannot skimp on equipment as unless you have all the parts and motors, you cannot use the robot, and lessons are delayed. This leaves children disappointed and they lose interest. The EV3 Lego equipment needs time-consuming, routine maintenance – charging the batteries, installing software updates on the laptops and the bricks, sorting the Lego and taking apart and rebuilding, when necessary, ready for the next session.

In my clubs/lessons I introduce flowcharting at each stage to help the children coordinate their thoughts to systematically break the task down (abstraction). I do this even for a simple task to get them used to the concept of computational thinking. I generally get the children to walk through the task before they start to programme and to produce a step-by-step solution or an algorithm.

Topics covered

The following shows an outline of topics covered during the course of the clubs/lessons:

Topic 1 Initially I introduce the children to the EV3 brick and the Mindstorms programme on the laptop. I encourage them to investigate the basics on the software, such as motors, sound and pictures and then download their instructions to the EV3 brick. The children are surprised at the immediate response of the EV3 to their instructions when sounds and pictures are displayed and the attached motors move.

Topic 2 Next the children build a fairly simple robot that takes about 20 to 30 minutes. The length of time varies between seven minutes (yes, there are children that are that quick!) to 50 minutes. I do not intervene unless they are desperate and they usually get there. Then it is basic programming to get the robot moving and turning.

Topic 3 Depending on the number of weeks for the club, I provide a roadmap for the robots to navigate that requires moving forwards and backwards and turning. Distances

have to be calculated and tested, along with angles. This exercise is fairly straightforward but repetitive and gets the children very familiar with the software. They are very competitive to complete the task first.

Topic 4 Then it is on to using sensors; the ultrasonic is always a fun session. The EV3 robots are programmed so that when you put your hand in front of the robot it will stop or possibly turn away and stop. If you put a repeat loop in, it turns away from your hand again and again (iteration). The children enjoy this as it is similar to developing their own toy, and who can blame them as it is fascinating to watch and play with the robot that they have programmed.

Topic 5 The colour sensor is another great sensor to use. You can programme the robot to detect a dark line and then give it instructions to move away. Again, by introducing repeat loops, it can do it continuously, and if you draw a circle with a thick, dark line, successful programmers can keep their EV3 robot within the circle.

When all the robots are put in the circle together, it is chaotic, as the EV3s knock each other over. The last robot standing is the winner, and, wow! do the children get enjoyment out of this exercise. You have to be a good programmer to win.

Topic 6 There is a third motor that attaches to the EV3 brick that drives a gripper or pick-up object attachment that the children have to build. Once programmed and working, the ultrasonic sensor is then added to detect an object for the attachment to grip/pick up. Programming is becoming more complicated at this stage, and it is possibly time to consolidate and regroup.

Topic 7 The final session of the term is a fun session when the children accessorize the robot. It involves designing, extensive building and working as a team to produce a good, working robot.

Conclusions

In the first term of the club/lesson, we have already achieved much with motors and sensors. The next term involves consolidation and more advanced programming with switches and extra sensors.

Recently I have purchased the EV3 Lego Space Challenge. It is perfect for reinforcing the previous sessions in an exciting futuristic space environment. Depending on the ability of the child, they have to solve challenges that can be completed at many different levels from easy to advanced.

When I watch children programming and downloading to the EV3 brick to drive their robot, I see the delight on their faces. It reminds me of a quote: from Seymour Papert, Professor of Learning Research, MIT, inventor of Logo computer language and collaborator with Lego to produce Mindstorms: "Children learn best when they are actively engaged in constructing something that has a personal meaning to them – be it a poem, a robot, a sandcastle, or a computer program."

Finally I think it is important to relate where robots are used from robotic vacuums, car-park barriers and remote medical operations to searching for earthquake survivors.

I play many videos showing working robots at the end of my sessions. As I have a keen interest in space and exploration, I introduce workshops with talks to link our robots with the unmanned 'robotic' missions that are currently underway and controlled from Earth so as to fuel the imaginations of the children. Current missions include Juno, Curiosity, Cassini, Voyager 1 & 2, Rosetta amongst others.

I like to think that one day our young roboteers will be inspired to play a part in developing robots to change the world for the better. But if not, at least it will, hopefully, make them think about and be aware of the increasing role of robots in our everyday lives.

This article is adapted from a longer article that appeared in the HIAS newsletter, *User Friendly*.

To find out more about the Robot Clubs, please email liz: lizstoneham@yahoo.co.uk