Case Study BP609: Remote-controlled electronic robot

Abstract

Reference: Case Study BP609
Classroom Practice: Year 10
Title: Remote-controlled electronic robot
Overview: In this unit students are introduced to electronics through the construction and programming of a remote-controlled robot.
Focus points: The case study highlights:

- Teacher planning
- Resource preparation
- Student engagement and motivation
- Skill and knowledge development
- Addressing individual needs
- High quality achievable outcomes

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Background

John Foster has a background in electronic and electrical engineering in the UK energy industry. He taught in his native Yorkshire for a number of years before taking up his present teaching position in the technology department at Havelock North High School in 2004.

John teaches Year 9 Technology, Year 11 Graphics and wood-based senior technology classes and Year 10 electronics modules.

In 2005, a new technology programme was developed and introduced at the school, so that in Year 9 all students at the school follow a common technology programme. This gives them experience in a range of technologies and opportunities for progression in their technological practice.

John was given the opportunity to develop an electronics area within the new technology facility and designed a series of 'training kits' for student use including one to assist in the development of programming skills.

After gaining extra knowledge and skills in this area through ETITO electronics courses delivered by Andrew Hornblow, he developed the one-term electronics module featured in this case study, which has been offered as a Year 10 option for the last two years.

John's first Year 10 electronics module option was offered in 2005. The main project was the development of a programmable alarm system, preceded by a skill-building keyring/light project. For 2006 the main project involved the construction and programming of a remote-controlled robot, using the Picaxe chip.

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Pre-planning

Planning for 2006 centred on designing a module that ensured all students could produce an individualised robot at a reasonable cost within the limited time available. A 'babysitting' context was selected to help students to engage with the project and an introductory student booklet was designed to introduce them to electronics, components and systems.

A resource booklet was also produced to guide students through their technological practice towards the development of a quality solution and to structure student learning within the time constraints of a 10-week module.

Having seen the need for clearer instructions from the previous year's class, John also created an animated PowerPoint presentation of the intricate construction details, which students could access when required.

To cater for the range of ability in his classes, John provided three project options: a basic robot kit activated by one key on a TV remote control; the basic kit plus a student-constructed remote control to provide greater manoeuvrability; and a robot with a larger chassis with two 12-volt motors each with their own remote control.

The module was to be offered three times in 2006, and John included sufficient flexibility to enable modifications to be made as the year progressed.

John established a relationship with KEI Ltd, a Hawkes Bay electronics company. Managing director Barry Kent has a keen interest in promoting electronics in school technology programmes and was more than willing to help John with the initial selection and sourcing of components.

"There's a huge demand for technological and engineering skills in New Zealand and industry is desperate to attract young people with an interest in electronics. If we can generate this sort of a relationship with schools we'll give students a much better appreciation of what's going on in the electronics industry and why it's important. And we'll get more young people coming in at all levels with a genuine zest for it." Barry Kent

Schools in the Hawkes Bay region interested in receiving similar assistance in developing electronics as a context for technology education can contact Barry at info@kei.co.nz

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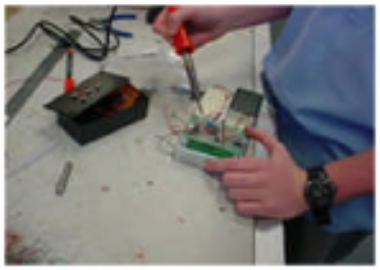
Delivery



The module begins with an outline of how the classwork will be structured over the term. Attention quickly turns to the development of the knowledge and skills which the students will need for their project and this is structured into three distinct parts.

John follows his brief introduction to electronic systems by giving the students the opportunity to use his Demonstration System Kits to connect typical Input, Process and Output boards together and to show the working outcomes to the rest of the class. In the third part of the introductory stage the students design and build complete electronic circuits of increasing complexity. The power source for these circuits is taken off the bench terminals at each of the student work stations.

The technology cycle which students become familiar with in their Year 9 technology programme is then revised. Students are introduced to the issue they will be addressing and given the class brief.

Students spend some time in planning their practice and then further knowledge development takes place built around integrated circuits and the particular Picaxe chip which they will be using. A series of programming exercises is attempted using the class set of test circuit boards which John has developed.

Students then move on to write their initial brief with specifications and, after carrying out basic research on robots, develop and screen a range of concepts. Ongoing stakeholder evaluation leads into the final development phase with the production of a working drawing and flowchart showing the sequence for manufacture - with quality control checks structured into the process.

Students then formulate their final brief with a list of specifications for their developed solution.

Manufacture involves the component assembly of the Printed Circuit Board (PCB) and then the following of the test procedure to power the board up. Students then construct an MDF base to mould the plastic body of their robot.

Students complete their project with a final evaluation of both their solution and the practice they have followed.

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Outcomes

John found that students engaged immediately with the coursework and were highly motivated to learn what they needed to produce their own working robot.

"As soon as I mentioned the word 'robot', their minds started to buzz they liked the idea of programming the latest technology."

With the resource booklets and PowerPoint presentation to refer to when required, students could work more independently and at their own pace. This ensured that most students were able to pick up the required electronic knowledge and skills and understand the basic workings of the chip.

"They're making something that they're keen to get working and they're learning all about the electronic components they're using. There's a wide spread of abilities in the class and I've made sure that everyone can get a successful outcome and the quicker students can be extended as well"

All students had an immense sense of achievement by the end of the module. Many had developed competency and understanding to a level that genuinely challenged John as to how they could extend the performance of their robot. This forced John to continually upskill himself and to think of new avenues that students could pursue.

While ongoing preparation of student resources was hugely time consuming, it resulted in greatly improved student practice and quality of the outcomes produced.

"It's taken a lot of developing but it means that in class I've been able to focus more on explaining what's going on and why they are doing things this way. And the result is that they're not having to come to me so often to ask things."

What the students say about the module:

"It's been good, even if you haven't done any electronics before." Logan

"At the start I thought it was going to be horrible because it looked like I was going to be the only girl but then it turned out to be really exciting!" Denise.

"I thoroughly enjoyed the unit it taught me lots of new skills in electronics and programming." Daniel.

"At first I was scared of doing things and failing.. but with the help of my teacher and other students I now enjoy electronics." Tiho.

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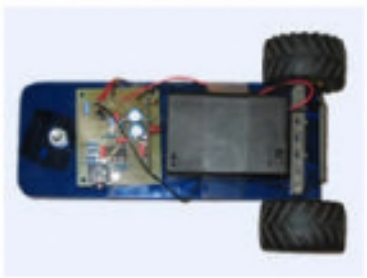
What next?

The success of first two years of the electronics module has motivated John to design a new two-term course, which will be offered for the first time in 2007. The longer timeframe will benefit both the students who need more time to complete their basic project and the more able students who wish to push themselves further and develop more sophisticated outcomes. A major constraint of the one-term module has been the lack of time for students to incorporate individual design features into their completed robot. In term 4 2006 John successfully trialed a new design project which he will incorporate into the 2007 two term Year 10 electronic programme.

The introduction of a Level 1 NCEA materials/electronics-based technology course for students who have a particular interest in electronics has also been confirmed for 2007.

View a movie of one of the new car robots (120kb, .mpg)



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