Encouraging Young Engineers (EYE)

Outreach workshops designed to encourage young people to take a look at engineering

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Abstract

This project has supported the development of outreach workshops for delivery by university student volunteers in local schools with the aim of engaging young people from under-represented backgrounds in Engineering. The workshops explore how different engineering disciplines contribute to the design and development of high tech products, specifically focusing on the interaction between software and hardware. The workshops were developed in collaboration with WMG (formerly Warwick Manufacturing Group), LEA representatives, BCS colleagues and local teachers. One has already been delivered at a local school and at several teacher conferences in 2011 with the assistance of student volunteers from Warwick University. The intention is to continue delivery of this outreach workshop and to proceed with delivery of the others to local schools through the University volunteer scheme (Warwick Volunteers) from 2012 onwards.

Keywords: outreach, hardware, software, undergraduate volunteers

Background

There is an opportunity to take advantage of an existing interest in and fascination with aspects of technology by young people in KS3 before they have made subject choices for GCSE by which time barriers may already be put in the way of a subsequent engineering career. Most young people use technology every day, but rarely consider the underlying principles, because the products are designed to be easy to use and hide the underpinning technologies.

Warwick Volunteers provides opportunities for students and staff at the University to volunteer in a variety of roles, within the local community. The Technology Volunteers scheme operates through Warwick Volunteers, who provide CRB clearance and safeguarding training. The Technology Volunteers scheme has run software development workshops in local schools for 4 years. In recent years the scheme has attracted almost equal numbers of male and female student volunteers from a variety of backgrounds, giving a positive mixture of role models. Student volunteers are enthusiastic about their subject, and are able to engage with young people. Creating new workshop resources that the volunteers can use in schools increases the range of workshops they can run and enhances their skills.

Through existing voluntary activities there is a well established informal collaborative network with good links already in place between representatives of the Coventry LEA, local schools and universities, the Coventry Branch of the British Computer Society, and the IET. The advantages of a local collaborative approach to this aspect of outreach work are described in detail in paper [1].

WMG is an academic department of the University of Warwick.   It carries out applied and practical research under three main themes: Materials and Manufacturing; Digital Manufacturing, Technologies and Healthcare; Operations and Business Management.   Postgraduate education programmes, based at WMG and centres overseas, include full-time MSc's and Research Degrees (PhD and EngD) as well as part-time Professional and Executive Programmes for managers with technology-led companies.

Rationale

Highly sophisticated devices, which are designed to be easy to manipulate without an understanding of how they work are embedded in our society, and as a consequence young people from all groups and backgrounds are immersed in this technology.   This immersion provides an opportunity for us to encourage young people to reflect on how such devices operate and in what possible ways they could develop in the future. By its nature the programme crosses engineering boundaries, with potential for different focuses for a variety of workshops.

Existing engineering workshops often engage pupils by encouraging them to construct mechanical apparatus, but do not take advantage of the ways in which disparate branches of engineering converge to produce a modern high-tech product.

The immediate outcome of this project has been extend the range of workshops offered to local schools, delivered by university students through the Technology Volunteers scheme (go.warwick.ac.uk/techvolunteers). Existing workshops focus on software development activities, whereas the workshops developed in this programme enable us to extend and develop activities into other areas of engineering.   Equipment and resources purchased for the pilot will have continuing use in the Technology Volunteer workshops, and in other outreach activities undertaken through the University.

The long term objectives intended to be met by the workshops is that by targeting the schools and groups of pupils to whom the workshops are delivered we expect to engage pupils from under represented groups, and raise the profile of engineering as a possible career.   We hope that some of these pupils will, as a consequence of the workshop, go on to study engineering.

A side benefit of this project is that the student volunteers are encouraged to become STEM Ambassadors through the Technology Volunteers scheme.   The skills and confidence of the volunteers who take part in this programme are enhanced, leading to them becoming more effective STEM Ambassadors.

To summarise the aims of this project:
- Raise awareness and interest in engineering profession and careers
- Work with young people from groups that are under represented in higher education
- Encourage female participation, through use of female role models
- Creation of resources for use by Technology volunteers & STEM Ambassadors
- Broaden skills of current volunteers

The Approach

Young people carry sophisticated mobile phones around that have many sensory capabilities, so giving them an insight into how the hardware and software interacts, and the use of sensors in these devices became the focus for this project. The approach taken by this project was to focus on creating a short 1 hour workshop for pupils in Key stage 3 that gave an insight into how sensors were used in mobile phones, and this covered aspects of the Design and Technology and ICT school curriculum.

The ideal scenario for a workshop is to deliver it to whole classes in local schools where few pupils aspire to higher education, or have significant awareness of engineering careers, using student volunteers as accessible role models. Working with a whole class ensures that everyone in the class is introduced to the concepts in workshop, and that groups of people aren't able to opt out of it because they believe it is *"not interesting"*.

The intention is to make the delivery of the workshops developed through this project sustainable by including them into the menu of activities offered to schools through the Technology Volunteers scheme. The expectation was that students who participated in the pilot would help mentor the next generation of volunteers in these new workshops, thereby forming a self sustaining group of practitioners.

Collaborators on this project were colleagues in WMG, representatives of LEA's, members of local professional bodies (BCS and IET) and the local STEMNET co-ordinator. The LEA advisors are particularly valuable in providing good contacts with schools that could benefit from the scheme. Other useful sources of information were the LEP (London Engineering Project) case studies, which provided useful guidelines on the format of workshops [2].

The preliminary stage of the project was to identify and agree specific topics that would interest young people. Input from the local collaborators was particularly helpful at this stage, both in ensuring a clear focus, and also in considering what other activities could spin off from an initial workshop.

The plan was that workshops should act as springboards, rather than closed activities, and also be flexible enough to be amenable to extension in a variety of ways. It was also important that new workshops were designed to build on the existing skills of the student volunteers, and that the apparatus involved in workshops supported open ended activities. To this end careful consideration was given when purchasing equipment to support the workshops.

The development stage consisted of investigation of the ideas for the workshops in a semi structured way with the student volunteers in order to refine our ideas as to what would work well, and the approach to be taken in presenting the workshops to school pupils to maximise their engagement.

The final workshop materials were prepared taking into account this investigation.

Evaluation

There are two sets of feedback on the workshops: informal feedback from teachers and formal feedback from school pupils to whom the workshops were delivered.

Feedback was obtained informally from teachers after the workshop was delivered to them at the local ICT&L teachers' conference [3], and at the national conference CAS 2011 [4]. This was generally positive, but some concerns were expressed about whether school pupils would have the

ability to interface effectively with the graphical block programming environment used in the workshop.

Formal feedback was also obtained on the workshop delivery from a year 10 ICT class (whole class - pupils not selected), and from a self-selected year 9 group. Due to timetabling difficulties it was only possible to run the workshop with one KS3 group (year 9) and a year 10 group. The experience was generally found to be positive, see charts below (based on 17 responses out of 19 pupils in year 10, and 13 responses out of 17 from year 9).
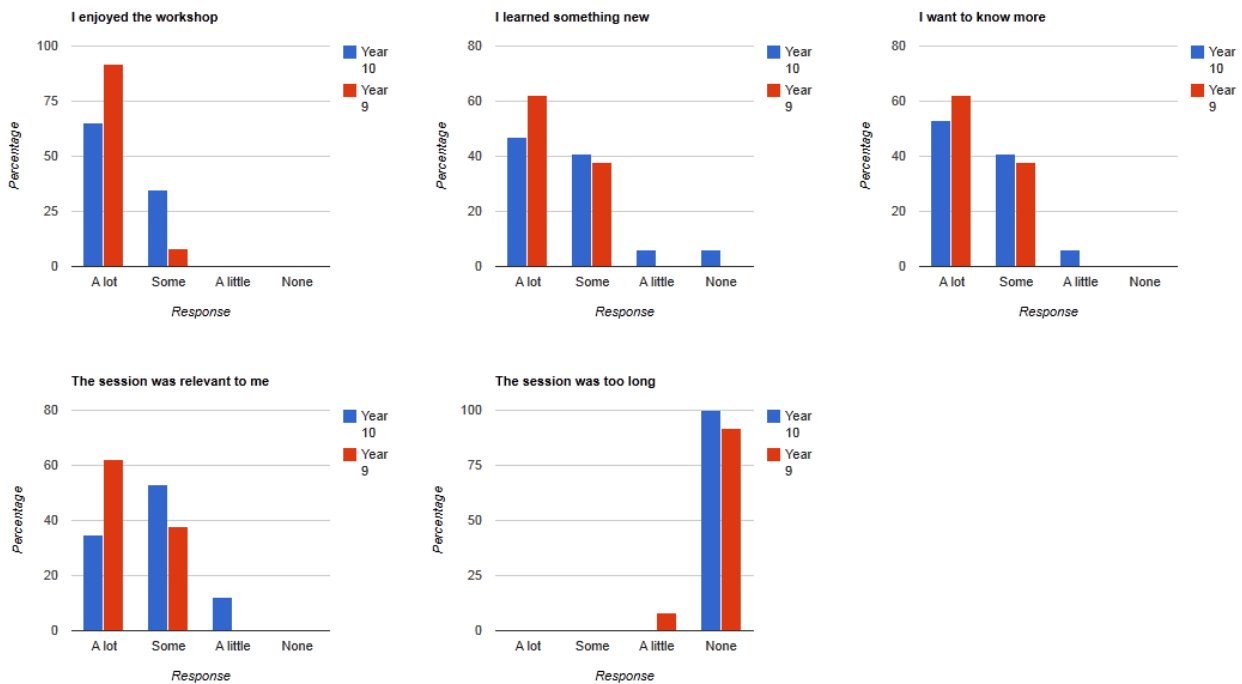
It is worth stressing that the year 10 group feedback shows a positive experience similar to that of the self-selected year 9 group, even though the year 9 group consisted entirely of male pupils who opted into the session. Although this is clearly a small amount of data it suggests a significant disparity between the expectation and the actual experience of girls in Engineering and Computing which deserves further investigation.

Further refinements to the workshop materials will be made to try to improve relevancy figures, and to give guidance on further resources to ensure pupils can continue their personal development after the workshop.

Discussion, Summary

Overall this project has supported the development and presentation of successful workshops to engage school pupils in aspects of Engineering and Computing. A number of different resources have been produced. One workshop tutorial has been published online, and circulated at ICT&L 2011 [3] and CAS 2011 [4], while others are currently in production and awaiting wider distribution.

The original intention was that students involved in the school pilots would mentor and train the 2011-2012 cohort of student volunteers. In fact this didn't quite work out because key student volunteers were offered industry placements, and the students that participated in the pilots are no longer at Warwick. At the start of the academic year in October 2011 it was straightforward to train this cohort of volunteers in the new workshop as many of them already had experience with the programming environment – hence we have reached the same level of sustainability as planned though by a slightly different route.

In term 1 these student volunteers underwent CRB clearance, safeguarding training, as well as training in the new workshop. This fits with the aim of Warwick Volunteers to encourage and support student led projects. In term 2 they will be delivering the extended range of workshops in local schools.

In the preliminary stage of the project, the hardware required to support the workshops (Scratch sensor boards) were identified and purchased.   Scratch is a programming language produced by MIT, and freely available, which provides an excellent introduction to software development and control [5]. The volunteers already have experience of Scratch and its use introducing software development to school pupils [6]. These sensor boards cost under £40 each, and a set of 20 were purchased to support a typical computer lab in school. The boards can be connected to 4 additional sensors, so give plenty of scope for further workshops.

In the development stage, we came to the conclusion that a particularly engaging activity would be to give the pupils a simple keyboard controlled game, and have them adapt it to use the sensor board as a game controller. This was the particular activity we developed as a pilot workshop. Some other possibilities arose involving the inclusion of additional sensors.   Rather than purchase 'off the shelf' solutions, the idea was to get young people to build them. For example a simple tilt sensor can be built using a plastic bottle, two pins and salty water. Workshops based on these other ideas are currently in development.

One significant loss to this project was closure of the Coventry & Warwickshire STEMNET contract holder in March 2011, in the interim time I established contact with the West Midlands region STEMNET, however in October a new Coventry area contract holder was appointed, and contact has now been made with them.

The equipment purchased has also supported other outreach activities, including the Imagineering@Airbase Fair 2011 and a public workshop in the BBC Coventry and Warwickshire Open Centre.

In conclusion we have
- developed workshops to engage KS3 school pupils in Engineering and Computing
- formed a collection of equipment and resources that can also be used to support other additional outreach activities
- gathered some interesting evidence on contract between the perception and actual experience of girls regarding Engineering.

Further Development

There is still a great deal of scope for development of homemade sensors and their application in conjunction with the scratch sensor board, including the tilt sensor mentioned above and making links to the science curriculum.

There is also the exciting possibility of bringing these ideas to the general public rather than concentrating purely on children of school age. We are organising a family workshop during the February half term holiday hosted by the BBC Coventry and Warwickshire Open Centre. We have also been invited to run a sensor workshop for the Coventry branch of BCS in an evening meeting aimed at interested adults. We hope this will provide the opportunity for synergistic interactions with people from a variety of backgrounds.

References

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