Embedded use of iPads to enhance student engagement and retention in technical education

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This paper focusses on attracting and retaining young people into technical disciplines. It introduces a new model of technical education from age 14 that the UK Government initiated in 2008. A concept of University led Technical Colleges (UTCs) for 14-19 year olds. These state supported schools, sponsored by a University, have technical curricula, technologically enabled learning environments and strong engagement with employers. As new schools they have been able to recruit outstanding staff that are conversant with the use of technology to enhance learning and all students have their own iPads. The Aston University Engineering Academy opened in September 2012 and a recent survey of staff, students and parents has provided both qualitative and quantitative data on the benefits to motivation and learning of these embedded iPads. The devices have also had advantages for the management of data on student achievement from a leadership, teaching staff and parental view point.

Keywords: iPads, technical education, student engagement, data management

Context

There is a global challenge to encourage more young people in the UK, Europe and US to study physics, mathematics and engineering disciplines. The concern has been recognised by the European Organization for Economic Co-operation and Development (OECD, 2006) who evidenced a significant decline in young people's interest and motivation to study Science, Technology, Engineering and Mathematics (STEM) subjects. The report recognised that in Europe far greater numbers of people are going to Universities than ever before but not in the STEM subjects. Similarly, in the US it was reported as a concern in 2005, and again in a report for the National Research Council (2010). This declining engagement with disciplines that are key to the economic success of countries is now a major cause for concern. The reasons for lack of interest in the science and engineering disciplines are complex; however, there is firm evidence that a major factor is the way in which Science and Mathematics is taught and the expertise with which it is taught from early years, through tertiary education and in Universities. The report from the High Level European Union Group on Science Education chaired by Rocard (2007) concluded that science subjects are often taught in a much too abstract way, which leads to young people viewing science as irrelevant and difficult. It was concluded that school science is often detached from everyday life and work experience. Better links are needed with the real world of engineering, including practical examples taught by people who are passionate and understand the application of these disciplines in industry.

Engineering educators agree that pedagogical practice based on inquiry and problem based methods are more effective. However, the reality of much classroom and lecture theatre practice means that a traditional didactic approach is still prevalent in the sciences and engineering. Work by Henderson and Darcy (2011) recognised the significant limitations of traditional, knowledge based transmission but change has been slow. In the UK in 2011, a parliamentary report on 'Technicians and Progression', from the Skills Commission chaired by Halstead (2011) confirmed this trend and also highlighted the huge skills gap between young people leaving school and university and the skills, knowledge and competences that employers want.

The scale of the challenge means there that we have to reflect on a more aligned and sustainable technical education model which must embed and exploit the available technologies and digital skills of the young to enhance and enable their learning. Mobile devices can bring science and engineering directly into the classroom with significant benefits but these devices have yet to be used on a wide and embedded scale. Tablets are used by all generations and global sales have already outstripped the numbers of personal computers sold. There is growing research of the benefits. Burden (2012) who led the i-pad Scotland evaluation showed clear evidence of the motivation for learning. This was also one of the conclusions from a study on a secondary school in the UK by Heinrich (2012). All studies have confirmed the benefits of personal ownership but Heinrich reported that senior students commented that some staff didn't use them and they could be more creatively used. There are growing pockets of global reviews on the potential, by for example, Melhuish and Falloon (2010), the Department of Education (2011) in Queensland, and successful small scale application in specific disciplines

(Osmon, 2011). There are few published evaluations at tertiary level where issues of staff willingness to implement and the ICT budgets are reported to inhibit widespread growth (Bingimlas, 2009).

Against this background, this paper is about a new and innovative approach being implemented by the UK Government in England, known as University Technical Colleges (UTCs). These schools, with new technologically rich learning environments, have embedded technology in their learning and teaching and leadership approaches. The next section looks briefly at the curriculum and approach of one of these centres of excellence in engineering education, the Aston University Engineering Academy for 14-19 year olds which opened in September 2012. All students at the Academy have their own iPads. It was a £17.2 million new building adjacent to Aston University.

Aston University Engineering Academy; the first university-led technical college in the UK

In December 2007, discussions with Aston University, Birmingham in the UK, led to the concept of University Technical Colleges for 14-19 year olds. In the five development years, technology was embedded from the beginning as part of the vision; the building was designed to create both formal and informal spaces as well as within the learning and teaching strategy. The development also capitalised on the University's relationships with employers to ensure the most appropriate equipment in the academy, that is, iPad ownership for all. An outcome of a recent evaluation of the use of iPads in Scotland, Burden (2012) and Heinrich (2012) confirmed the benefits to successful learning were assured through a partnership with the Birmingham e-learning foundation for a small monthly fee. This University-led school effectively took the best of the University practice (work experience and employer input to the curriculum), and research informed practice (in terms of learning and teaching) to create a new and bespoke science and engineering learning experience for 14-19 year olds. It also embedded a curriculum partnership model with employers, that was implemented for the Engineering Diploma for 14-19 year olds in 2007 by Aston University and partners, (Halstead & Kilgour, 2008).

In 2012, Halstead and Kilgour highlighted the importance for University technical departments to engage with this Government initiative to raise aspiration and progression into technical disciplines and jobs. Success in science and engineering requires high level mathematical skills but also practical knowledge. The visualisation of concepts and processes is extremely important, and through their iPads teachers and learners can quickly and rapidly access examples as well as being able to share them. The aim to make learning authentic, collaborative and personalised as suggested by Kearney, Schuck, Burden and Aubusson (2012) provides an overall aim for iPad use.

The Engineering Academy has a unique focus on Engineering, Physics, Maths and Chemistry with a strong emphasis on communication which is delivered in a problem based and highly motivating way. The learning is contextualised through strong links with local and national industrial, commercial partners and university researchers. These partnerships have also enabled the Engineering Academy to support local schools where it acts as regional lead for: the Formula 1 Challenge for tertiary schools; as well as the Jaguar Land Rover's primary engineering challenge for the under 10s. This educational and employer type of curriculum partnership along with the exploitation of technology to enhance and enable learning is at the heart of the development of University Technical Colleges. Barriers to successful implementation of ICT into tertiary education cluster around two main aspects: firstly that of staff, their confidence, competence and knowledge of the best resources and pedagogies; and secondly technical issues within the environment (Bingimlas, 2009). In the case of the Engineering Academy, the new buildings provided the opportunity to ensure a well-designed and resourced technical environment with iPads for all. Also, as a new school, all teacher appointments were for outstanding teachers (assessed through the delivery of a lesson) who were already using a range of approaches in their teaching and were willing to take risks (assessed through application, lesson and interview). The Engineering Academy recently gained a 'good with outstanding features' rating from the national audit body (Ofsted), the highest that such a new school can have. The remaining part of the paper focusses on an evaluation survey that was conducted with students, staff and parents at the end of the second year after the Academy opened.

Evaluation of iPad use in the Engineering Academy

Three surveys were conducted within the Academy and administered to staff, students and parents/guardians. They were designed to ascertain staff perceptions of the benefits, to gain a better understanding of how the iPads were being used, and to obtain insight into any disadvantages or opportunities that were currently being missed. Parental views and their perceptions of the benefits for students were also measured through a survey.

A total of 613 questionnaires were distributed through Bristol on-line to 283 students, 279 parents/guardians and 51 staff. The staff has the highest response rate at 82%, the students at 73% and the parents at 38%. This compared well with general research questionnaire engagement, which is often much lower, and is the first indicator of good engagement with both the technology and the engineering academy.

Staff views

Staff responses indicate that they enjoyed using the technology and saw it as a way of making the learning more interesting and relevant. Some commented that the opportunity to use technology with all their learners was one of the reasons for applying to the Engineering Academy. The approaches reported were varied and those most commonly occurring are listed.

- Able to bring in alternative illustrations and examples of the application or use.
- Immediate access to the internet and endless resources.
- Immediate access to multimedia and a range of apps.
- The ability to quickly google or search Wikipedia for answers.
- Mutual interest of facts and knowledge.
- Learning together.
- Open questions that we seek the answers to.
- Capturing processes as they happen to be reviewed later.
- Able to review student results immediately and plan interventions.
- Being able to personalise and pace learning to keep all students motivated.
- I feel that I am a better teacher.

In terms of disadvantages and opportunities, staff commented that they would like to have more time to share their learning and teaching practices as well as engage with external professional development opportunities. They wanted to know if there was a national resource for the best resources because they felt bewildered with the array of sources. They felt that there was an opportunity for students to work with them to locate the best resources and that this source would grow over the years.

Student views

Students were equally positive about similar aspects confirming that the iPads were used in most lessons, and that they felt that they were useful in lessons and while travelling to and from the Academy for reviewing work. They also used them for watching films and chatting with their friends within and external to the school during and outside of lessons! Eighty percent of students reported using their iPads on a daily basis outside of school. The most commonly reported benefits are listed.

- Great to access to the internet and extra resources.
- Being able to video processes and demonstrations really helps me to learn.
- Lessons seem more interesting and go much faster than at my previous school.
- There is a real pace to the lessons and the learning.
- The iPad helps to bring science alive.
- The teachers really trust us and treat us as grown-ups.
- Exam preparation seemed easy, being able to attach pertinent resources to the questions.
- It is easy to contact teachers by email.
- I feel more organized.
- The apps for the I-phone are brilliant.

In terms of disadvantages and opportunities, students commented that some parents felt they spent too long on the iPad. They also felt that their teachers could help by directing them to the best resources. Overall they reported very few disadvantages and no opportunities.

Parent views

The majority of parents (68%) had strongly supported the leasing scheme and use of iPads. Positive comments included:

- evidence of pupils spending more time on school work
- greater interest in science and engineering
- increased confidence
- more conversations on topics about school.

Along with these positive responses, there were also the greatest numbers of concerns raised, the main one being, the time that was being spent on the iPad, which they were not always sure was on school work.

Discussion and conclusions

Students' and parents' views on the iPads were consistent with previous studies, Burden (2012), Heinrich (2012) and Osmon (2011), with regard to the benefits to learning and interest in the subjects. Other studies commented on the increased aspect of collaboration between students and assistance in teacher workload issues. This was not picked up in this study. However the uniform benefits to all subjects in this new school may reflect that the Engineering Academy's focus is Mathematics, English and Science, subject areas found in the Heinrich study to have the most engagement. The advantage in this school is that staff were specifically recruited on the basis of delivering a good/outstanding lesson and an interest in technology. The new technically orientated curriculum within a technology rich learning environment has also circumvented any technological problems that Bingimlas (2009) commented on. Parental concerns were the time that students spent on the iPad. Students confirmed that they moved easily from school work to films and chat as you would expect of the current generation. Comments from the students on being trusted and treated as grown-ups were frequently made and this may be due to the greater maturity of young people willing to transfer at 14 into a new type of School. Several responses from students mentioned the pace of lessons where resources and applications were useful to illustrate material reflecting the high levels of motivation and interest in the technical disciplines. This is consistent with the personalisation and authenticity required to enable successful learning (Kearney, Schuck, Burden & Aubusson, 2012).

One other advantage was the ability to view and track data on performance which was successful for parents, staff and pupils and for successful interventions to be personalised. The overall success of the implementation is that the Engineering Academy has been designed for technical training and had a technologically rich learning and teaching strategy. This has enabled staff to focus on integrating the learning and teaching effectively, using innovative practices, and openly sharing and accessing knowledge with the learners. There is the evidence from the students that they do feel empowered and motivated to learn through this approach in exactly the way Melhuish and Falloon (2010) concluded they should. This early study appears to demonstrate a successful and growing use of the iPads, welcomed by parents and students, and well used by staff who simply want more time to develop even better ways of utlising the iPads. A full analysis of this research will be published at a future date.

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