Exploring ICT integration as a tool to engage young people at a Flexible Learning Centre

The Edmund Rice Education Australia (EREA) Flexible Learning Centres aim to provide a supportive learning environment for young people who find themselves outside of the mainstream secondary schooling system. Drawing on 21st Century learning principles, the Centres aim to deliver a personalised learning experience with an emphasis on flexibility and individual choice. Provision of a comprehensive curriculum enables young people to make positive future life choices and successfully transition into employment and further training. The aim of this research project has been to work with teaching staff at a Flexible Learning Centre in North Queensland, Australia, to explore the value of integrating ICT in the form of Web 2.0 technologies to enhance young people's engagement with the subject of science. The findings of this case study suggest that ICT integration is effective in revitalising science education interest for disengaged young people. This may have wider implications in relation to general concerns of declining student interest and participation in science in the secondary years of schooling.

Keywords: Science education, Flexible learning, ICT integration

Introduction

Education commentaries refer to the need for students to develop a repertoire of 21st century skills and competencies in order to successfully transition from school to further education and work. Competencies considered vital for success in the 21st century workplace include the ability to problem-solve, think creatively, collaborate and innovate (Cisco, 2007). Development of these 21st century competencies is aligned to a pedagogical approach that emphasizes personalised learning, reinvigorated educational spaces and innovative curriculum delivery (Leadbeater, 2008). Pivotal to this type of learning is the application of innovative information and communication (ICT) technologies that best allow educators to facilitate contemporary forms of teaching and learning (MCEETYA, 2005).

However, meeting the challenge of ICT currency is no easy task for schools in that "digital technologies morph and change quickly at a rate that generally outpaces curriculum development" (Johnson, Smith, Willis, Levine, & Haywood, 2011, p.4). Schools are often left 'behind the times' with outdated forms of hardware and software as well as organisational restrictions in relation to how they engage with more modern ICT tools such as Web 2.0 technologies. Compounding challenges include a lack of teacher training and ongoing professional development in the best use of newer technologies as well as a shortage of practical examples in relation to how these might be employed to increase both the engagement and future success of diverse student cohorts (Walsh, Lemon, Black, Mangan & Collin, 2011).

This paper hopes to contribute to an identified gap in the research field by providing a practical example of engaging diverse young people through the incorporation of newer technologies. This study forms part of a larger Australian Research Council project titled 'Re-Engaging Disadvantaged Youth Through Science' which explored the potential of engaging marginalised young people through the medium of science and technology education. The aim of the case study reported within this paper has been to investigate how ICT (specifically a selection of Web 2.0 tools) might be integrated into a unit of science education work to cater specifically to the engagement needs of students who have found themselves positioned outside of the mainstream schooling system and instead attend a Flexible Learning Centre.

The Flexible Learning Centre context

The Edmund Rice Education Australia Flexible Learning Centre Network (EREAFLCN) commenced operation in Queensland, Australia, twenty-five years ago with the aim of providing an alternative learning pathway for young people who had found themselves completely disengaged from the mainstream secondary schooling system. Young people attending these centres come from diverse cultural backgrounds and have often experienced complex life circumstances including homelessness, contact with juvenile justice and child safety systems, young parenting and disability (EREA 2010). They have also generally experienced large gaps in their schooling due to school absence, suspension and/or expulsion which has had a negative impact on the development of their basic academic skills.

While the personal challenges young people face can at times seem insurmountable, they bring many unique talents that have often remained unrecognised in the mainstream schooling setting. Being tracked into lower ability classes with an emphasis on remedial literacy and numeracy work has in many cases denied young people an opportunity to demonstrate their often considerable talents for creativity, design and problem-solving. Key to the EREAFLCN approach is recognition of the strengths that students bring to the educational setting and an organisational philosophy that encourages teachers to be innovative in finding ways to foster these unique capabilities (EREA 2010).

Drawing on 21st Century learning principles (Leadbeater 2008), the Centres aim to deliver a personalised learning experience with an emphasis on flexibility and individual choice. Anticipated educational, economic and social outcomes for young people attending these centres include completion of secondary certificates of education, attainment of introductory and advanced level vocational qualifications, successful transitions into traineeships and apprenticeships, securing of safe housing and the development of positive relationships with individuals and the wider community.

Engaging young people in a full suite of educational activities encompassing all key learning areas as prescribed by both state and national curriculum documents is vital in ensuring that post-school options for students are broad rather than limited in scope. Provision of a comprehensive curriculum enables young people to make positive future life choices and successfully transition into employment and further training. Equity and necessity demand the inclusion of science within the education program however young people often resist engaging in the subject due to preconceptions that science is both ‘hard’ and ‘boring’.

Student engagement with science

The issue of student engagement with the subject of science remains a key concern for educators both internationally and nationally. Fensham notes mounting international concern about the “failure of recent school science curricula to foster interest in science as a career or as a lifelong interest” (2004, p.1). He highlights disengagement in science as the greatest contemporary problem facing science educators (Fensham 2004). In the Australian context, Tytler (2007) calls for a ‘re-imagining’ of science education in order to combat the evidence of a continuing decrease in student enthusiasm for science subjects and related career pathways. The draft national K-10 Australian Curriculum for Science (Australian Curriculum, Assessment and Reporting Authority 2010, p.1) states that “an issue for science education in Australia is not so much the performance of our students on international tests, but rather student engagement and interest in science”.

The Relevance of Science Education Project (ROSE) identified key affective dimensions related to student engagement and interest in studies of science and technology. Primary elements included students’ attitude to, and appreciation of, science and technology as human constructs or achievements.

The ROSE study highlighted the importance of affective outcomes in relation to students' personal and potentially life-long orientations towards science as a field of interest (Schreiner & Sjoberg 2004). While a considerable body of research has been dedicated to exploring the affective dimensions of engagement and their impact on student learning in the mainstream schooling context, there is little data available in relation to how disengaged young people might be encouraged to develop a positive orientation towards science and technology.

The role of ICT in enhancing engagement for disadvantaged young people

According to a recent report by Walsh et al. (2011) that provides a comprehensive overview of the role of technology in engaging disenfranchised youth, the continued emergence of new information and communication technologies (ICT) represents a valuable opportunity for finding novel and innovative ways to reconnect disengaged young people with an educational or training program. Within the report, ICT is understood as a broad term encompassing applications of technology including the Internet, mobile phones and devices, gaming, assistive technologies, digital photography, music and media production. The authors note the prevalence of personal ICT use by young people, further supported by data from the Australian Bureau of Statistics (ABS) that indicates 96% of 12-14 year olds in Australia access the Internet and 76% of the same age group own a mobile phone. Young people "use ICT frequently and in a variety of ways; as a source of information, entertainment and social communication" (ABS 2011, p.1). While there is some disparity in relation to access across socio-economic groups, those young people who cannot access online activities at home often make use of school facilities, resulting in an across the board high level of overall access for young people living in Australia. According to Walsh et.al (2011, p.2):

> …even those young people who are typically most at risk of disengagement from learning expect ICT to play an integral role within their daily lives. They also expect it to play an integral role in their learning. Young learners want and expect flexible and engaging learning environments that effectively use ICT.

Flexible and engaging 21st century learning environments

Common characteristics referred to in descriptions of an ideal 21st century learning environment include an emphasis on personalised learning, provision of dynamic learning spaces and integration of new and emerging technologies (see, for example, Keamy, Nicholas, Mahar & Herrick 2007; Leadbeater 2008; Walsh et al. 2011). According to the MCEETYA *Learning in an Online World* series of publications, "pedagogies that integrate information and communication technologies can engage students in ways not previously possible, enhance achievement, create new learning possibilities and extend interactions with local and global communities" (2005, p.2). Teachers are encouraged to integrate ICT into their pedagogies in order to motivate and engage their students; personalise learning; engage with diversity to support inclusiveness; develop ICT literacies; establish communities of learning; and assess progress and evaluate teaching (MCEETYA 2005). However, despite these calls for a more personalised and integrated pedagogy to suit the 21st century learner, Walsh et.al note that "there is still a marked lack of reliable and original research and evaluation in relation to the use of social or interactive technologies in pedagogy" (2011, p.3).

21st century learners and Web 2.0 technologies

21st century learners are commonly described as 'digital natives' and their approach to learning is influenced by "their expectations of 24 hour a day, seven days a week, three hundred and sixty five days a year multiple media communications" (MCEETYA 2005, p.4). Young people today are generally accustomed to the more recent Web 2.0 technologies including blogs, wikis, multi-media sharing sites, podcasting and social networking. This latest platform of technologies is underpinned by a changing communication interface with an over-arching orientation towards collaboration, contribution and community (Anderson 2007). Such a shift in the way people communicate, create and share information requires young people of today to develop a different skill set than that of the previous generation (McLoughlin & Lee 2008). However, according to Cisco (2007, p.6) “there are limited opportunities to leverage the creative and collaborative capabilities of Web 2.0 technologies in the classroom”.

Mobile devices and applications

According to the 2011 Horizon Report, mobile devices (including phones, iPads and similar ‘always connected’ devices) are near term adoption technologies set to change the educational interface over the next twelve months. As access to affordable and reliable networks continues to grow, mobile devices are becoming increasingly popular across the world as a primary means of accessing the Internet (Johnson et al. 2011). In terms of equity, mobile devices allow a larger proportion of the population to access online resources and Walsh et.al (2011) note that mobile phone ownership is rapidly becoming ubiquitous, even in highly disadvantaged contexts. The Horizon Report highlights the need to find ways to take advantage of a technology that nearly all staff and students carry in an educational setting and that provides instant access to information, social networks and tools for learning and productivity (Johnson et al. 2011). As innovation in mobile device development continues at an unprecedented pace, they become increasingly useful in education settings as a means of integrating ICT with minimal financial outlay and a reduced need for IT or support staff. Mobiles provide a range of educational opportunities which may take the form of electronic book readers, applications for creation and composition, digital capture and editing, self-study, reference and drill and practice applications (Johnson et al. 2011). MCEETYA consider mobile devices as vital components of an ICT rich learning space (2008), yet despite this, only a very small number of practitioners report using mobile devices or applications in their classrooms (Walsh et al. 2011).

Project methodology

The project described here forms part of a larger study exploring the role of science education in re-engaging disadvantaged youth. This four year longitudinal project has involved working in partnership with teaching staff at a Flexible Learning Centre site in North Queensland to trial and self-evaluate units of work with a science education emphasis. Data sources have included classroom observation notes acquired through extended time in the field, semi-structured interviews with teaching and support staff and a review of key organisational, policy and curriculum planning documents. Qualitative analysis of this data through a process of coding and progressive focusing (Simons 2009) has been directed towards producing case studies which illuminate the range of pedagogies employed by Flexible Learning Centre staff in order to engage diverse young people in science. It is a study of the particular in depth and as such, employs non-cross-sectional data organization to enable examination of discrete parts of the overall data set (Mason 2002). This allows an analytical understanding of the distinctiveness of elements of the data set, which, for this particular case, is centred upon determining the relationship between ICT integration and student engagement with science in the context of a North Queensland Flexible Learning Centre.

The North Queensland Flexible Learning Centre (FLC)

The North Queensland Flexible Learning Centre is situated in a regional town of the tropics with a population of close to 200 000 people. The centre is registered as a secondary special assistance school and currently enrols approximately 85 young people (attendance and enrolments fluctuate). There is a slightly higher ratio of male to female students and approximately 40% of the young people attending the North Queensland centre identify as Indigenous. Through the recent provision of government funding, the school is gradually transforming from a fairly basic facility of a series of small classrooms to a more dynamic learning space incorporating new hospitality, music and outdoor facilities as well as a proposed science laboratory and manual arts working area. However, until the new science laboratory is built, there exists no dedicated science space or area to store related work items which requires teaching staff to be inventive with everyday items and the facilities at hand. While comparatively under-resourced in the science department, the centre is well-resourced in terms of ICT. The centre has two computer labs available with good quality hardware and software, Internet access, digital cameras and recording devices and a recent acquisition of a set of iPads. Teaching staff at the centre readily integrate the use of ICT in their classroom activities due to its widespread appeal across the student cohort. However, the integration of ICT with science has yet to be fully explored due to the sometimes tenuous position of science education within the FLC curriculum. With few facilities and resources available to support a science program, it requires a motivated teacher to take on a subject that the majority of young people resist engaging with.

Potential of ICT in engaging young people in science in the FLC context

Young people attending the Flexible Learning Centres are prolific users of technology with the majority owning at least one form of mobile device with online capabilities. In a context where it can be challenging to engage young people with learning, it can be ironically difficult to disengage them from their mobile devices. While it is not supposed that the nature of these activities are necessarily educational (and authors such as Kymber & Wyatt-Smith (2010) indicate that much youth online activity is in fact banal and superficial), it would be remiss to ignore the opportunity to build on the ways young people are constantly engaging with this technology for their own purposes.

It is through this medium that young people appear to indulge their natural curiosity in science related topics. While their own investigations appear to be somewhat indiscriminate, they often report information that they have discovered via media-sharing sites such as YouTube and even social networking sites such as Facebook that would indicate an orientation towards science learning. However, when science is introduced as a topic in the school setting, the student response is often demonstrably negative. The intention of the ‘rocket science’ project has been to create a learning environment evidencing greater seamlessness between ICT and science in order to enhance young people’s overall engagement with science and technology.

The junior rocket science project

Teacher background

The teacher and co-author of this report is an early career professional in her mid-20s. Her teaching experience has incorporated both primary and secondary settings with her current role at the Flexible Learning Centre requiring her to broadly teach across the junior secondary curriculum. As a relatively young person, the teacher is at home with Web 2.0 technologies including the latest generation of mobile devices and is a frequent user of media sharing platforms such as YouTube. While her experiences of school science were that of minimal engagement she was able to pursue her own personal interest in science activities outside of school hours that contributed to her belief in the need for science to be hands-on, practical, fun, creative and contemporary. Her vision of science education for young people at the Flexible Learning Centre centres on the establishment of a supportive atmosphere that encourages students to try new things, learn from failure and support each other in collaborative endeavours.

Student participants

Students at the Flexible Learning Centre are streamed into Junior and Secondary Classes but remain with the same teacher for the majority of schooling time primarily in recognition of the importance of consistent teacher-student relationships in improving outcomes for disengaged young people. While requiring a broader range of subject mastery on the teacher's behalf, this beneficially enables easier subject integration as the same group of students remain with the same teacher for most learning experiences. The group of all male students who participated in this study comprise half of the junior cohort of the Flexible Learning Centre with a median age of 14. Young people in this class are still in the early stages of re-engaging with the learning process and often struggle to participate. Significant literacy challenges contribute to a disinclination to participate in written activities which often manifests in shut-down behaviours. Additionally, some students in this class have a recognised learning disability that negatively impacts on academic progress as it is traditionally recognised.

Project impetus

The impetus for this project arose through informal conversations between the researcher and teacher as to how science might be incorporated into the following term's learning activities. Drawing on her positive experiences with science, the teacher had brought in her backyard experiment books from her childhood and had asked for assistance in building on these simple activities to create a unit of work. She was aware that she would have a challenge on her hands in engaging students as most students reported prior negative experiences with school science. However, through a process of student consultation she was encouraged to note some enthusiasm towards science as it exists outside of the school domain. Realising that students primarily accessed science content of their own interest through the conduit of television and the Internet, she intended for the unit of work to make best use of visual information sources. She hoped that such use would engage students in the topic of study and also assist those who struggle with literacy to process necessary content thereby enabling full participation in class activities.

Coke and Mentos activity

The first activity trialled with students to attempt to engender some initial interest was the Coke and Mentos 'geyser' experiment made familiar by the TV program Mythbusters. The teacher and students used their classroom set of iPads to research associated YouTube clips and then replicated the activity outside at school. Students performed the experiment in a variety of ways, intuitively testing different variables to measure the associated effect on the height of the Coke/Mentos reaction. After completing the practical activity, students then watched the related Mythbusters episode via YouTube in order to understand in more depth the science behind the experiment. That they were absorbing rather than just viewing the video is evident in students' write-up of the activity where explicit reference was made to the scientific content explained in Mythbusters. The fact that students were even willing to try writing up a report on the activity was considered a good sign in relation to engagement and reinforced the teacher's perception that the combination of YouTube, practical activities and later reinforcement of scientific content was instrumental to encouraging young people's participation in science.

The Water Bottle Rocket Unit

Capitalising on students' evident interest in YouTube, the teacher modified her original unit of work (which had a greater emphasis on chemical reactions) into one with a focus on water bottle rockets which was well-supported by video material within the YouTube platform. Coincidentally, there was a state-wide competition for school students to compete in a water rocket bottle challenge which provided additional momentum for the unit of work. Overall, the Water Rocket Bottle topic was considered conducive to seamless integration of ICT and an experiential orientation towards science learning.

The core activity of the unit was the development of a water bottle rocket through a cyclic prototyping process of design, testing, evaluation and modification. A water rocket is a chamber (usually a plastic soft drink bottle) partially filled with water. Air is forced inside using a pump (or air compressor). When the rocket is released, the pressurized air forces water out of the nozzle (bottle spout) and the bottle launches itself in the opposite direction. Testing the effectiveness of modification of different rocket design elements allows students to conduct 'fair tests' and gain experience in controlling and manipulating variables.

The water bottle rocket activity is particularly effective in demonstrating Newton's third law that for every action there is an equal and opposite reaction. In the case of real-life rockets, the action is the force produced by the expulsion of gas, smoke and flames from the rocket engine and the reaction force propels the rocket in the opposite direction (Shearer & Vogt 2011). With the water bottle rockets, the air pumped into the rockets builds up a significant amount of pressure, which, when the bottle is released, forces the water out of the opening and propels the bottle skyward.

Practical implementation of the unit

As with the Coke and Mentos activity, students firstly viewed YouTube clips to develop an overall sense of the purpose and nature of the activity. They then made a rough mock-up of a water bottle rocket in order to immediately engage with the hands-on process of launching and testing. Subsequent practical activities saw students modifying and re-testing their rockets, drawing on knowledge developed through reinforcing classroom-based activities. Modifying and testing activities took place outside to allow launching to an appropriate height and due to the messy nature of the activities that generally resulted in a large amount of water being dispersed. Classroom-based activities were still practical in nature with sample activities including students constructing paper gliders and attaching paper clips to test the potential effect of weight on the rocket nose cone and balloon/straw experiments to explore propulsion effects.

Recording activities

Students were provided with a workbook which allowed them to keep a weekly record of their rocket design and modifications by means of drawings and explanatory prose. For those students who particularly struggle with writing tasks, the teaching staff transcribed while the students narrated a recount of their problem solving activities. Additionally, photographs and video were taken of the practical activities and some student recounts were also video-taped. The photographs were intended to complement students' workbook activities as a visual record and the video provided a source of material for students to create their own instructional video to be uploaded to the school website.

Use of iPads

Access to a classroom set of iPads allowed the teacher to integrate ICT in both classroom and outdoor practical activities. Mobile device applications related to the topic of study were first tested for usefulness and then pre-loaded by the teacher onto the iPads. A favourite application of students that also played a useful education role was the 'Wind Tunnel' App which allowed students to draw shapes onto the iPad screen and then see the resulting graphic display of wind flow affects around their shape. This app also allowed students to visualise pressure effects and points of weakness in their rocket design elements. Students accessed YouTube clips via the iPad and also conducted website research and online activities through this medium. The online interactive activities provided by NASA relating to Newton's Laws of Motions proved engaging for young people through this format, something attributed to the video nature of the activity and the fact that students were able to replay videos and answer questions at their own pace. The fact that use of the online medium was able to engage students with more complex scientific concepts was encouraging to see.

While there were insufficient iPads to provide one per student, the teacher considered this beneficial as students worked together in groups of their own accord and through this group interaction, provided peer mentoring when others experienced difficulties without the need for teacher intervention. The collaborative learning aspect of the use of iPads was an unintentional but welcome outcome. The teacher noted that young people were often reluctant to ask for assistance for fear of appearing foolish in class but were more willing to accept assistance from their peers, particularly when working with technology. ICT was considered as a great 'leveller' in the Flexible Learning Centre setting in that it provided a place where all young people could meet despite disparities in their academic abilities in other subject areas.

YouTube

YouTube was critically important in engaging young people's interest in the water rocket bottle unit. While students had not previously demonstrated a particular interest in rockets or space science, they were highly engaged with the YouTube clips demonstrating the potential capabilities of water bottle rockets. The YouTube clips motivated young people by presenting the possible outcomes of water bottle rocket design and provided tangible evidence that this activity worked, and was of interest, to the real world. The teacher noted that watching the YouTube clips was what really drew the young people into the unit and she doubted that there would have been anywhere near the same level of interest without this incorporation of social media. As well, YouTube provided invaluable in assisting with the learning of young people as they appeared to quickly grasp hold of ideas that they had watched via video. An example of this occurred when the teacher provided paper-based instructions for the paper glider classroom activity and students struggled to understand the dotted lines and folding instructions. When the teacher then changed tack and allowed students to access YouTube clips on their iPads showing people actually constructing paper gliders, the young people quickly understood what was required and successfully completed the activity. In this sense, YouTube videos provided an engaging avenue for modelling the activities of instruction.

Student Participation

During the course of the water bottle rocket unit, the majority of students attended and participated in every lesson. Some students reported back to the teacher that they were in fact taking their work home and modifying their rockets in their own time, with the help of siblings and other local young people. At a school where homework is not set due to a range of reasons including the sometimes difficult home circumstances of young people, this enthusiasm to continue with work outside of school time is a very positive outcome. The fact that they were also sharing these activities with others shows that it would seem to hold value for young people outside of the school setting. With the primary intention of this unit being to find a pathway to encourage and develop young people's interest in science, this translation from the classroom to the neighbourhood provides important evidence of a prolonged interest that extends beyond teacher and classroom expectations.

An advantage of the outdoor nature of the activities associated with the water rocket bottle unit was that it created a contagious energy which even attracted students outside of the instructional class. The dynamic nature of students being outdoors constructing rocket bottles and the dramatic lift-offs and resulting waterfalls caused a number of older students to try to join with the junior class. One senior student asked at a morning assembly "why can't we do any science like the junior students" which is a fairly unusual aside in this context. Having young people actively photographing and videotaping activities as well as visibly modifying their rocket designs with the help of the Wind Tunnel app gave the work a sense of modernity that is so often missing in science classrooms. This also helped to attract those young people who might be less interested in science but more interested in ICT.

Conclusion

ICT integration plays an important role in capturing students' interest in a topic and creating dynamic links to real world situations and scenarios. Mobile devices are advantageous to learners with literacy challenges in that they provide avenues to alternative modes of learning such as video modelling and auditory information delivery. Additionally, ICT demonstrates the potential to assist young people in overcoming their fear of academic failure, in that they may feel more competent and capable in the ICT domain than they do in the science education domain. They are able to act as leaders in assisting other young people and teaching staff in the use of ICT, whereas their previous positioning in mainstream secondary science education settings may not have been as positive. ICT integration would seem to play an important role in overcoming students' negative prior experiences with school science and in developing a more positive general orientation towards science. The argument of this paper is that starting 'where young people are at' in their highly connected, technology rich life worlds might be a critical point of engagement. Schreiner & Sjoberg (2004, p.21) state that "only by meeting the learners at *their* premises can science teaching contribute in developing young people into concerned, empowered and autonomous individuals".

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