Institution: The Open University

Unit of Assessment: C25 Education

Title of case study: Enabling publics to participate in science learning through technology

1. Summary of the impact

Our research on technologies in science learning has led to increased participation by young people and adults in science, shifting their understanding of the scientific process. Impacts include:

- 24,000 active participants have used the prize-winning iSpot website and app to develop their understanding of species identification, making 250,000 nature observations and identifying new species
- support for distributed teams of science learners using new configurations of laboratory-based and mobile technologies which have been adopted by Microsoft to support their community engagement projects
- over 300 children using the open source nQuire software to undertake personal inquiries in community settings; nQuire underpins the new UK Girl Guides' Association 'Neighbourhood Researcher' badge.

2. Underpinning research

Researchers within the Centre for Research in Education and Educational Technology (CREET) have identified how participation in science learning can be increased in quality and reach by using technologies. The Practical Experimentation by Accessible Remote Learning (PEARL) project (€2 million) was led by The Open University (OU) with Trinity College, Dublin, University of Porto and University of Dundee. It investigated methods and technologies for supporting remote laboratory work via the internet with a focus on accessibility (disabled learners were included in the collaboration). A series of evaluated trials led to a remote learning model. PEARL established the feasibility of this model, which incorporates experimental work, collaboration and feedback provided by peers and tutors. The research identified the effects of the technical infrastructure on the interactions between students, tutor and apparatus, and highlighted the importance of understanding this relationship. The importance of creating opportunities for *participatory* learning was also established by the PEARL project.

While PEARL had success with undergraduates, evidence was mounting of the disengagement of young people with science at school level. In contrast, learners of all ages were successfully engaging with *informal* science, often as part of citizen science projects aligned to their own interests. These two themes of (1) enabling participative and collaborative learning and (2) making science personally engaging underpinned questions within subsequent research projects, and also informed the development project, iSpot.

ESRC/EPSRC funded the Personal Inquiry (PI) project (2007–10) which involved the OU and Nottingham University. A series of field trials were held in two secondary schools where pupils engaged in science inquiries investigating their environment. Addressing the issue of disengagement from science at school, the project confirmed the value of personalising inquiries by incorporating elements of personal relevance, choice and learner responsibility. It developed a conceptualisation of the process, the Inquiry Cycle, and explored the effects of using a dynamic model of this cycle (embedded within supporting software) to develop metacognition of the scientific process. The project researched the implications for technological support, examining the process of scripting inquiries, which can be modified or authored by teachers. It also addressed the challenges of multiple settings, as pupils moved between school, fieldwork, clubs and home, using PCs and mobile technologies.

EPSRC funded the Out There and In Here (OTIH) project (2010–11) which identified how computing technologies, including mobile and static devices, can be combined to achieve collaboration within distributed teams. It secured in-kind contributions from Microsoft and the project design company 'The Sea', who contributed to collaborative design workshops. The project

gathered empirical evidence of learners' interactions during collaborative inquiry in three different settings. Teams were distributed with some participants gathering, sharing and interpreting live data in the field, and other participants working within a static 'mission control' room. Learners' use of a multi-touch table top device, laptops, screen projections, video streams and telephones were tracked, with particular attention being placed on mapping transitions between technologies and on their contribution to collaboration. A conceptual framework was developed for analysing these 'device ecologies'.

Our research expertise was recognised by a grant from the National Endowment for Science, Technology and the Arts (NESTA) to develop Isotope, a member-driven website with information resources for the science public engagement practitioner community. An action research process was used to investigate the skills and knowledge of practitioners and to inform site content.

Key researchers

E. Scanlon, Regius Professor of Open Education; M. Sharples (from 2011), Professor of Educational Technology; Professor K. Littleton, Professor (Psychology in Education); Dr A. Adams, Senior Lecturer; Dr D. Clow, Lecturer in Interactive Media Development; Mr M. Cooper, Senior Research Fellow; Dr R. Holliman, Senior Lecturer; Dr A. Jones, Reader in Educational Technology; Dr C. Kerawalla, Lecturer in Childhood and Youth Studies; Dr T. Collins, Research Fellow; Dr C. Blake, Research Fellow and Dr P. Mulholland, Research Fellow.

3. References to the research

1. Littleton, K., Scanlon, E. and Sharples, M. (eds) (2012) *Orchestrating Inquiry Learning*, London: Routledge (Personal Inquiry project). ISBN: 978-0-415-60113-9.

2. Scanlon, E., Colwell, C., Cooper, M. and Di Paolo, T. (2004) Remote experiments, re-versioning and re-thinking science learning. *Computers and Education*, vol. 43, nos. 1–2, pp. 153–63 (PEARL project). ISSN: 0360-1315.

3. Coughlan, T., Collins, T.D., Adams, A., Rogers, Y., Haya, P.A. and Martín, E. (2012) 'The conceptual framing, design and evaluation of device ecologies for collaborative activities', *International Journal of Human-Computer Studies (IJHCS)* vol. 70, no. 10, pp. 765–79. DOI: http://dx.doi.org/10.1016/j.ijhcs.2012.05.008 (some authors had left the OU at time of publication).

4. Clow, D. and Makriyannis, E. (2011) 'iSpot Analysed: Participatory Learning and Reputation' in *Proceedings of the 1st International Conference on Learning Analytics and Knowledge*, 28 Feb-01 Mar 2011, Banff, Alberta, Canada, pp. 34–43. DOI: 10.1145/2090116.2090121.

5. Holliman, R., Collins, T., Jensen, E. and Taylor, P. (2009) *Isotope: Informing Science Outreach and Public Engagement. Final Report of the NESTA-funded Isotope Project*, Milton Keynes, The Open University, ISBN N978-1-84873-414-2.

The journal named above employs an anonymised peer review process.

Research funding

2000–03: €2 million awarded by the European Commission to Mr M. Cooper for a project entitled 'PEARL (Practical Experimentation by Accessible Remote Learning)'; partners were Trinity College, Dublin, University of Porto and University of Dundee.

2010–11: £250,000 awarded by EPRSC to Dr A. Adams for a project entitled 'Out There and In Here (OTIH)'.

2007–10: £1.2 million awarded by ESRC/EPSRC to Professors E. Scanlon and M. Sharples for a project entitled 'Personal Inquiry' in partnership with University of Nottingham.

2007–09: £100,000 awarded by NESTA to Dr R. Holliman for a project entitled 'Isotope: Informing Science Outreach and Public Engagement'.

4. Details of the impact

iSpot was developed as part of Open Air Laboratories (OPAL). It is a social learning community website where the public participate in real science through recording nature observations. Its development was supported by a £2 million National Lottery for England grant. It drew on understandings from our earlier PEARL research, notably the importance of enabling collaborative learning experience where participants actively gather data in the field, and build on feedback from peers, to reach scientific conclusions. It extends PEARL's approach by using technology to support interactions between learners, science experts and the natural world.

iSpot has developed technical skills and understanding of species identification amongst the iSpot user community. Sir David Attenborough, broadcaster and naturalist, commented: 'Learning the names of animals and plants is great fun. […] iSpot has already had a great success in encouraging people of all ages and all backgrounds, to take this first step.' The website has received over 1.4m visits by 500,000 unique visitors and over 24,000 user registrations making, between them, 250,000 nature observations. There are also more than 100 different UK natural history organisations accredited representatives on the site. Face-to-face outreach work has reached over 55,000 beneficiaries, over 10,000 from hard-to-reach groups, whilst over 800 participants have used iSpot at local 'bioblitz' events, including schools, local government and voluntary sector organisations. A new iSpot Android app has been launched to widen reach and increase mobility. iSpot is a key element of the new OpenScience Lab, a joint project between the OU and The Wolfson Foundation. The key impact is increased engagement in field biology, resulting in not only more data gatherers, but more data.

iSpot observations have been significant, including the first UK sightings of two species of insects. More fundamentally, iSpot has significantly contributed to a transformation of practice in biodiversity monitoring. Professor Sir Neil Chalmers, while Chair of the National Biodiversity Network (NBN), commented: 'iSpot has been taken up enthusiastically and has already proved its worth. […] The information from iSpot is made even more valuable by being fed, once validated, into the UK's National Biodiversity Network'. iSpot is recognised in a Department for Environment, Food and Rural Affairs White Paper as a tool for the public to engage in nature monitoring (HMG, 2011, p. 56) whilst excellence and impact was recognised by winning the Panda Award in the New Media category in 2010. The impact of iSpot is increasingly international: a sister site for Southern Africa was launched in June 2012 in partnership with the South African National Biodiversity Institute and has already attracted more than 66,000 nature observations.

The Out There In Here (OTIH) system, developed through workshops with Microsoft, combines mobile and static technologies to support effective collaboration across distributed teams. In one application, participants combined fieldwork and laboratory comparisons to identify mistakes in the British Geological Survey (BGS) Map, which the BGS then corrected. This success inspired further input from Microsoft into community engagement projects, notably work to explore the learning potential of a Cambridge cemetery. The OTIH system supported diverse local groups as they investigated the cemetery, including a local history group, a biodiversity group of local students, and a drama group from Parkside School. This work has led to sustained changes, influencing ongoing work around the cemetery by Cambridge Council. At Parkside School a follow-up evaluation one year later revealed sustained changes in teachers' practices and students' perceptions of technology-supported field trips (Van der linden et al., 2013).

OTIH has also had an impact on national government policymakers. Adams was invited to give a keynote to the UK Government's INSTINCT group (Innovation Science and Technology in Counter Terrorism). This led to security policy makers changing their perspectives on how to coordinate 'mission control' with security operatives in the field. Using the conceptual framework developed by Coughlan et al. (2012), they identified the need to reduce information overload for those in the field, such as police officers, by identifying and sequencing key situated knowledge of relevance to the task.

The software, nQuire, resulted from design and testing work with teachers during the Personal Inquiry (PI) project. It draws on research findings by incorporating structured activities linked by the Inquiry Cycle, data probes, visualisation of data, and means of communication. During the project, nQuire was used by 300 children, aged 11–14 years, and seven teachers on a range of

personalised scientific inquiries, such as urban heat islands, heart rate and fitness, and microclimates. Evaluations identified positive learning outcomes which were significantly greater than those of a control class, alongside an increase in the enjoyment of science.

Work by Kerawalla used the PI project's 'Inquiry Cycle' to support Girl Guides in developing and conducting small local inquiries, leading to the UK Girl Guides' Association's decision to award a new 'Neighbourhood Researcher' badge, now available nationally. Impact on the Guides themselves is addressed in our 'Empowering children and young people' case study. nQuire is available for free download, including for mobile devices, from www.nquire.org.uk. It has attracted 1900 separate visitors with software installed 70 times in educational institutions. nQuire has also been integrated into the OpenScience Lab, where it has been combined with a virtual microscope to enable the public to investigate samples of moon rock. Its authoring tool allows investigations to be set up in new areas, providing a platform for citizen-led science investigations.

5. Sources to corroborate the impact

iSpot:

- HM Government (2011) *The Natural Choice: Securing the value of nature*. Available at http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf.
- iSpot wins PANDA award in new media: http://www.wildscreen.org.uk/news-releases-panda-awards-go-green.html.

Out There In Here:

- Treasurer and Official Geologist for the Bucks Earth heritage group who manage the Coombs Quarry and coordinated the corrections to the BGS map inaccuracies.
- Chief Executive Officer, Security Innovation and Technology Consortium (SITC).

Personal Inquiry:

- Use of PI in developing a new Guide badge. Further information can be found at http://www.open.ac.uk/researchprojects/childrens-research-centre/crc-projects/streets-ahead
- iSpot and nQuire are available through the Wolfson Foundation-funded OpenScience Lab: www.opensciencelab.ac.uk.