Fully funded PhD Studentships - Based in Milton Keynes

Online teaching of practical science

The Open University is leading a major e-learning initiative to develop an ‘OpenScience Laboratory’ that will provide students and the public with opportunities to carry out science experiments and observations online. The work, funded by the Wolfson Foundation, involves national and international partners and has both teaching and research dimensions.

Applications are invited for fully funded full-time studentships associated with this initiative. The PhD projects cover a range of studies centred on e-learning, including practical science pedagogies, computing, knowledge management, data mining etc. The following are illustrative projects. There will be discussions to refine the project at the time of any offer of a studentship.

1. Shared web-based representations to support learning
   Prof Simon Kelley s.p.kelley@open.ac.uk or Dr Trevor Collins t.d.collins@open.ac.uk

   Technology-enhanced learning over the web offers an opportunity for communication between students and tutors that exploits the immediacy of the web as a channel for communication rather than just a channel for information distribution. Recent developments in web standards for interactive interfaces (i.e. AJAX and HTML5) and distributed services (i.e. REST and SOAP) provide the technical means for interacting with models, simulations and visualisations. These dynamic representations are used most effectively within educational situations where they offer a pedagogical advantage over the real thing. For example, a virtual microscope enables every user to view the same sample at the same time, which is not physically possible when using a set of real microscopes and samples. Within the context of group work and collaboration, shared representations provide an opportunity for multiple users to interact with the same representation simultaneously. A shared virtual microscope, for example, provides an opportunity for a group of users to work together on the same equipment, rather than working on identical (but independent) replicas. In this way, shared models, simulations and visualisations can be used within learning activities to enable students to demonstrate and explain their understanding of dynamic systems and processes.

   Developing technology that enhances the learning process relies on an awareness and understanding of what is technologically possible and educationally beneficial. Therefore, the development of shared representations to support learning requires a holistic approach that considers both the social and technological aspects of the activity. This PhD studentship will explore the application and development of web architectures and tools to support the production of shared web-based models, simulations and visualisations. Depending on the skills and interests of the successful candidate the project may innovate in areas such as web architectures, web development frameworks, participatory design methods, user engagement, learning design, and/or evaluation of educational technology.
2. Investigating affordances of 3D virtual environments for Science education
Dr Shailey Minocha s.minocha@open.ac.uk

Three-dimensional (3D) virtual environments, also called synthetic worlds, are multimedia, simulated environments, often managed over the web, which users can and interact from a first-person perspective and/or via ‘avatars’. A 3D environment can enable students to carry out a range of authentic and practical scientific enquiries: interacting with 3D models, participating in virtual field trips; learning to control instruments; assembling apparatus and instruments; and creating 3D models. The social aspects of a 3D environment support scientific discourse and dialogues at different levels.

This project will involve evaluating student experience and the pedagogical effectiveness of science activities that are already there in virtual worlds such as OpenSim-based and in Second Life. You will also be involved in designing and developing science activities in other 3D virtual environments such as in Unity 3D and evaluating student experience and the pedagogical effectiveness of the activities. You will investigate how the affordances of 3D virtual environments such as realism, spatial audio, sense of presence, sense of place, embodied actions including view control, navigation and object manipulation, and embodied verbal and non-verbal communication can facilitate science education in distance and blended education contexts, and can support collaboration amongst students and educators in geographically distributed settings and in different institutions.

You should have a Masters Degree in Computer Science or a in related discipline with a strong knowledge of Human Computer Interaction either through practice or formal qualifications, and must have scripting and programming skills in Javascript or C Sharp and with a keen interest in learning 3D modeling and Unity3D. Background in Science, instructional design, games design and the experience of conducting usability and pedagogical evaluations is desirable.

3. Exploration of designs, challenges and opportunities involved in extending citizen science to include inquiry-based science exploration.
Prof Mike Sharples mike.sharples@open.ac.uk

A December 2011 editorial in the journal for Science argues that wider engagement by citizens in “carefully designed, hands-on, inquiry-based exploration of the world” will inform public debate and may lead to scientific breakthroughs. A central and unsolved challenge is how to enable such widespread involvement in science by empowering people with reasoning and problem-solving skills used by scientists.

The focus of this PhD is to synthesise and extend existing projects in citizen science and inquiry based learning. The research will explore how members of the public can be supported by applications on personal computer technology (such as smartphones and tablet computers) to engage in science through inquiry, by collectively proposing, planning, enacting, analysing and presenting scientific investigations.

The studentship will involve methods of design-based research, where new science, technology and pedagogy are advanced through a series of design experiments. The type and range of the research will be developed through discussion with PhD supervisors. The outcome of the PhD research will be novel and evaluated computer-mediated methods for inquiry-based citizen science.

4. Supporting students’ conceptual understanding through analytics feedback on practical science investigations: an exploration of tools and mediating artefacts (e.g. learning analytics, visualisations and concept mapping)
Dr Anne Adams a.adams@open.ac.uk

This studentship will investigate how learning analytics and related visualisations support students and teachers in mapping current personal and collective levels of conceptual understanding. In reviewing these feedback mechanisms, knowledge of how to support appropriate conceptual focusing in teaching and learning activities will be generated. Through linking Wolfson research to the EU Juxtalearn science and technology project the following questions will be pursued: How can teachers identify and map current problematic concepts in practical science modules? How can learning analytic mechanisms support accurate feedback of current deep conceptual understanding rather than mimicking appropriate responses to pass an assessment? How can this knowledge be automatically obtained from analytics of current activities? What are the optimal tools and artefacts to support appropriate feedback that facilitate learner engagement and motivation?

5. Linking Nature to Databases with your Smartphone
Prof. Stefan Rüger s.rueger@open.ac.uk

You will research and develop analysis tools that recognise natural objects that your smartphone sees, e.g., rocks, plants, butterflies, etc.

Imagine you collect rock samples during a field trip, from which you hope to learn about geological formation millions of years ago. Your next step is to take a photograph with your smartphone and upload it into your analysis tool that extracts relevant colour histograms and texture features. These return a group of possible rock sample matches from a pre-indexed image database. You are now able to use the known properties of these rocks to validate or challenge prevailing theories of formations based on your very own observations.

This mechanism provides a link from a physical object, here the rock sample, to the database world of knowledge about rock samples via pressing the shutter on a smartphone and intelligent data processing. This PhD project will explore and research the underlying paradigm of indexing sensor data by suitable summary statistics and how this mechanism can be used to access scientific databases without the help of the traditional method classification schemes. The work will be carried out with the Multimedia and Information Systems Team of the OU’s Knowledge Media Institute http://kmi.open.ac.uk/mmis

6. A critical assessment of remote experiments in science distance teaching.
Prof Nick Braithwaite n.s.braithwaite@open.ac.uk and Dr Ulrich Kolb u.c.kolb@open.ac.uk

Remotely operable hardware for conducting scientific experiments and data acquisition, common in present-day scientific research, is increasingly being deployed to support undergraduate teaching of practical science. In traditional lab environments this is a technologically challenging but fairly straightforward as the apparatus is still nearby. The context for the Open University (OU) is different, as it has to cater for a large group of geographically dispersed students with limited scope for synchronous supervision.

There are a number of such remote experiments or facilities in use at the OU, such as PIRATE (http://pirate.open.ac.uk), a remotely-operable astronomical observatory, and PIXIE a remotely-operated laboratory interface currently featuring a Compton scattering experiment. Both of these facilities have training environments (simulators) that allow users to acquire operational skills before driving the actual hardware.

This project aims to evaluate the effectiveness of remote experiments in teaching science in general and practical science in particular. This will be achieved by analysing existing
data of student engagement and progression, and by devising a programme of investigations into how these facilities are being used. The aim is to identify the impact of the type and level of activity and the supporting resources on student engagement and progression.

These results will be discussed in a wider educational context but also used to optimize the deployment of the existing suite of experiments, and to inform their integration into the Wolfson Open Science Lab.

7. Design and evaluation of field-based science learning using mobile devices as scientific toolkits.
Prof Eileen Scanlon e.scanlon@open.ac.uk or Prof Mike Sharples mike.sharples@open.ac.uk

In recent years there has been an initial exploration of the prospect of social and mobile technologies for enhancing field trips. This is arguably challenging existing perceptions of time and space and modes of communication (see e.g. Charitonos et al., 2012). Recent projects at the Open University such as Personal Inquiry (Scanlon et al, 2011), Out There in Here (Couglan et al., 2011) have explored the nature of the support needed for learners in the field studying science and the Personal Inquiry project investigated scripted inquiry learning and mobile technologies in formal and informal science learning settings. This project developed a toolkit which facilitated the conduct of a scientific inquiry on a number of field trips (Anastopoulou et al., 2009) Mobile technologies have now become more educationally-appropriate through integration of improved multimedia functionality and improvements in aggregation and use of services, for example the powerful combination of picture capture, geo-location and ‘network awareness’ makes the current generation of smart phone technologies potentially beneficial for rich exploratory and discovery application. New models of inquiry learning have made use of the affordances of mobile technology and these may impact on the experience of the learner (Scanlon et al., 2005). Other theoretical approaches have also been applied to the consideration of mobile learning. A number of challenges remain in the design and evaluation of such mobile learning experiences. (Sharples, 2007). This studentship would tackle the challenges in design and evaluation of innovative uses of mobile technologies to support student learning on field trips.

References
Charitonos, K, Blake, C. and Scanlon, E. Museum learning via social and mobile technologies, British Journal of Educational Technology (in press)
Scanlon, E., Anastopoulou, S., Kerawalla, L. and Mulholland, P. (2011) How technology resources can be used to represent personal inquiry and support students’ understanding of it across contexts, Journal of Computer Assisted Learning, 27(6) 97-112
8. Technologies to enhance field-based science learning
Dr Sarah Davies s.j.davies@open.ac.uk

Practical work in the field is of fundamental importance in the earth and environmental sciences. Students acquire key observational and interpretive skills as they interact with the structures and processes of the environment in all its complexity. As well as providing practical and professional skills, fieldwork is recognised as important in engaging students such that they are more likely to use effective approaches to learning. Technologies such as mobile devices, environmental sensors, augmented reality and portable or pervasive wireless networks provide exciting innovations to enhance field-based learning and can demonstrate different ways in which students can interact with the environment and related environmental data. The challenge is to exploit these technologies to enable effective field-based learning.

This project will involve the design and evaluation of selected field-based science learning activities for university level students. These activities could involve remote participation in fieldtrips over wireless networks for distributed individual and group collaboration (see the Enabling Remote Activity http://projects.kmi.open.ac.uk/era/ and ‘Out There In Here’ projects http://www.open.ac.uk/blogs/otih/; augmented reality applications on mobile devices; the use of environmental sensors and open environmental data.

9. Scaffolding Citizen Science with Learning Analytics
Dr. Simon Buckingham Shum S.Buckingham.Shum@open.ac.uk

This PhD will investigate if the passion and curiosity that citizen scientists bring can be harnessed and developed into more reflective, scientific practice, through the use of social learning analytics.

A key driver for citizen science is participants’ passion and curiosity, which powers their engagement in the science ecosystem. However, if citizens are to progress beyond simple data gathering and classification, and shape the design of scientific efforts, a key challenge is to develop their capacities to engage in the reflective interpretation and argumentation that is the hallmark of scientific discourse. This PhD will build on pedagogical frameworks for authentic inquiry and social learning, as inspiration for designing new kinds of social media learning analytics that will scaffold citizen scientists, giving them feedback and coaching on how they can develop the transferable skills critical to joining a scientific community of practice, and the specific skills of reflective writing, argumentation and the making of scholarly claims. This PhD will be led by Simon Buckingham Shum, a leading researcher in Learning Analytics and Computer-Supported Argumentation, building on existing OU platforms such as Cohere, Evidence Hub and EnquiryBlogger.

10. Design and evaluation of online practical science experiences for students in countries with limited technical infrastructure.
Professor Steve Swithenby s.j.swithenby@open.ac.uk

The Open University has worked with a number of partners, particularly in Africa, to investigate the nature and delivery of the practical science curriculum in countries that have limited resources. In such countries, the shortage of laboratories is a very practical constraint on attempts to build capacity in university science education. Can technology help to mitigate this constraint? This question has many facets. It might be argued that countries with limited resources also have weak technical infrastructures which will limit the deployment of Information and Communication Technologies. However many such countries have well developed mobile networks and considerable ingenuity has been shown in using these networks, e.g. in supporting personal banking. It is pertinent too to ask whether the nature and uses of the laboratory experience are dependent on social
norms and expectations for both students and teachers. So, the construction of an ‘authentic’ practical Science experience may well vary with country.

In the Open Science initiative we are working with partners in Africa and will be exploring such issues to find practical development strategies. This research will extend and deepen such work to provide a conceptual base and toolkits that will inform longer term activities. It is expected that there will be close liaison with professional bodies in this project as well as visits to overseas partner campuses.

For an informal conversation, please contact the person identified for the project that interests you or, for a more general conversation, Professor Steve Swithenby s.j.swithenby@open.ac.uk.

The Open Science initiative spans several units; Science, Mathematics, Computing and Technology, the Institute of Educational Technology and the Knowledge Media Institute. Details of their wider research can be found at http://www.open.ac.uk/research/index.php.

For further details of postgraduate research at The Open University: see the Research Degrees Web pages http://www.open.ac.uk/research/research-degrees/overview.php where you can access the Research Degrees Prospectus and formal application forms. Please note that the Prospectus has not yet been updated to reflect these new postgraduate opportunities.

Financial Support:

Each studentship comprises a maintenance stipend (currently £13,590 per annum tax free) and payment of tuition fees. Overseas Students are eligible to apply.

Application Requirements:

Eligible applicants should have or expect to have a good Bachelor (Hons.) Degree of either First Class or Upper Second Class or hold a Masters Degree (MSc/MRes) in a relevant discipline. Overseas applicants will need to demonstrate adequate proficiency in English Language skills.

The Studentship is funded for 3 years. The student will be based in Milton Keynes. The anticipated registration date is 1st October 2012 (negotiable).

If you would like to apply then please complete the downloadable application form http://www.open.ac.uk/research/research-degrees/forms-and-guidance-notes.php. Indicate your area of interest and add any other information that you think may support your application. Send the form etc. to esteem@open.ac.uk or by post to

eSTeEM,
The Science Faculty
The Open University
Walton Hall
Milton Keynes MK7 6AA, UK

The Closing Date for Applications is: Friday 3rd August 2012.