Innovative technologies for learning and teaching

Pupils are improving their maths, and teachers are enhancing their lessons, thanks to computer systems developed by researchers at Birkbeck

There are many pedagogical benefits to using technology in the right way in the classroom and these are being demonstrated by a range of exciting projects. New tools produced by academics at the London Knowledge Lab in the Department of Computer Science and Information Systems have been put into use in schools across the world, including in London, and the feedback has been positive. The researchers follow an interdisciplinary methodology in which pedagogical theory informs the initial design of algorithms and tools. These are then iteratively evolved and enhanced through successive cycles of user-centred evaluation. Concurrently, pedagogical theory and practice are transformed through the provision of tools to education experts and practitioners.

iTalk2Learn

One of the major projects is called iTalk2Learn, which aims to develop an open-source intelligent tutoring platform that supports maths learning for pupils aged five to 11. Funded by the European Commission, this three-year Clin project recognises that young children are much more likely to respond to spoken, rather than written, instructions and suggestions. As part of the research, a speaking computer program has been designed to teach fractions to children aged seven to nine. Birkbeck is one of four universities involved in the research, and it is receiving approximately £500,000 for its part in the study involving schools in the UK and Germany.

Dr Sergio Gutiérrez Santos, Lecturer in the Department of Computer Science and Information Systems, is leading Birkbeck’s participation in iTalk2Learn, which ends in October 2015. He said: “The computer program speaks to the children, and we know this is a very effective way of teaching. The children are encouraged to talk through their answers, and voice recognition software enables the pupil to interact with them, and assess their performance. Children learn more from their mistakes than from their successes, and the iTalk2Learn system is designed to support their learning in an exploratory way.”

MiGen

Pupils have also benefited from computer-based tools when learning algebra, which is notoriously difficult for children to learn. In collaboration with the Institute of Education, researchers at Birkbeck have developed the MiGen system, which transforms the learning of algebraic concepts. Instead of working with symbols and equations, pupils use this software to construct 3-D tiling patterns and, simultaneously, develop algebraic rules about the properties of their patterns. The system was tested in schools in London, as well as at schools in Mexico, Singapore and Brazil.

MiGen’s main intelligent component, called the eGeneraliser, gathers information about pupils’ construction activities and uses this to make inferences about pupils’ progress in knowledge assimilation. The provision of real-time feedback to pupils without destroying the exploratory and creative potential of their interaction with the system is a major contribution of this research to the field of intelligent constructionist tools for learning and teaching. Teachers are also able to monitor the progress of their pupils thanks to a suite of Teacher Assistance tools, which can additionally suggest pedagogically informed pairings for group work, based on a detailed analysis of all the pupils and their work.

Alex Poulovassilis, Professor of Computer Science in the Department of Computer Science and Information Systems and Co-Director of the London Knowledge Lab, was one of the principal investigators of the MiGen project. She said: “This work was pioneering as it provides intelligent support to both students and teachers during constructionist learning activities. The feedback we received was very positive.”

The Learning Designer

The third major project in this area was the Learning Design Support Environment (LDSE), which was motivated by the need to support teachers in capturing their pedagogic ideas, testing them out, reworking them, allowing them to build on what others have learnt, and to share their results with their community. The Learning Designer promotes the concept of lecturers or teachers as designers, in that they use what is already known in order to keep improving their practice, to innovate, and to articulate and share that practice with others. The software allows users to upload existing lesson plans or to create new ones. It then analyses them and helps tutors to recognise how much of their learning designs are dedicated to various pedagogic practices (namely acquisition, reflection and production), and may suggest improvements.

The Learning Designer was adopted for training computer science graduates studying for the MSc in Educational Technology at the School of Pedagogical and Technological Education (ASPETE) in Greece and at the University of Macerata’s Faculty of Education in Italy in a module for trainee teachers.

Dr George Magnoulas, Professor of Computer Science in the Department of Computer Science and Information Systems at Birkbeck, was one of the principal investigators on the LDSE project. He said: “The tool is designed to encourage teachers to think about how they can improve the way they teach. It promotes novel approaches to teaching, encouraging tutors to break away from the traditional one-way instruction and move towards personalised learning experiences enhanced by modern technology.”

Both the £1.5m LDSE project and the £1.3m MiGen project were funded as part of the Technology Enhanced Learning Programme managed by the Economic and Social Research Council and the Engineering and Physical Sciences Research Council. They were both undertaken in collaboration with staff from the Institute of Education and other education specialists and practitioners. Birkbeck received £300,000 and £600,000 for the LDSE and MiGen projects respectively. The MiGen and LDSE projects were mentioned in Birkbeck’s submission for the Research Excellence Framework (REF) – an audit of the quality of all the research carried out in the UK higher education sector (p22).

The projects were both included in an impact case study, entitled Intelligent constructionist tools for learning and teaching, which was part of the submission for Computer Science and Informatics – one of the Units of Assessment. The results of the REF were announced in December 2014.

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