Researching the sciences of learning

Learning sciences is a relatively new interdisciplinary field of research that studies teaching and learning. The sciences of learning include cognitive science, educational psychology, computer science, anthropology, sociology and neuroscience. Learning sciences explore the relationship between the design of learning environments and how people learn. A common feature is the use of technology, both for learning and for research.

According to Sawyer (2005), scientific knowledge is an understanding of ‘doing science’, combined with deep knowledge of models and explanatory principles connected in an integrated conceptual framework. The practice of science involves experimentation, trial and error, hypothesis testing, debate and discussion.

Learning scientists are adding to what we know about learning. In Pittsburgh, USA, researchers at the Science of Learning Center are seeking methods to measure robust or deep learning: the learning that is retained for a long time, transfers to novel situations or aids future learning (www.learnlab.org). They argue that we need a sustained scientific effort, using laboratory tests and research in the field. They conduct experimental research in schools, using technology to capture fine-grained, long duration recording of student learning. These experiments include control groups, involve real courses and measure a small variable like a specific teaching method, rather than a specific technological device.

The Cambridge Handbook of the Learning Sciences (Sawyer, 2005) shows how educators can use the learning sciences to design more effective learning environments, including school classrooms and also informal settings such as science centres, museums, online distance learning, and computer-based tutoring software. At the Learning Sciences Research Institute at the University of Nottingham (www.lsri.nottingham.ac.uk), teams of researchers are working on projects including language acquisition and pedagogy; science in schools using mobile technologies; evaluating learning in museums; and underpinnings for the next phase of the UK’s education technology strategy.
Bransford, Brown and Cocking (2004, p. 243) suggest five ways that technology can help in establishing effective learning environments:

- Showing real-world situations through video, demonstrations simulations and online connection to concrete data and working scientists
- Providing scaffolding to enable learners to perform complex cognitive tasks, such as scientific visualisation and model-based learning
- Providing feedback from adaptive software tutors and local and remote teachers and peers
- Supporting online communities of learners
- Expanding opportunities for teachers’ learning.

At Carnegie Mellon University in the USA, researchers use data mining to analyse the interactions between students and educational software, in order to better understand how they respond to software such as intelligent tutors and educational games, and how these responses impact on their learning (Baker, Corbett, Roll & Koedinger 2008). They have developed automated detectors that make inferences in real-time about students’ motivational and meta-cognitive behaviour, using data from students’ actions with software. They have also created software that can automatically detect when a student is ‘gaming the system’ rather than by learning the material, as well as models that can determine whether an incorrect answer genuinely reflects a lack of knowledge, or is simply a slip.

Gaming the system is generally, but not always, associated with poorer learning: sometimes students ‘game’; with material they already know. The researchers have found that a student’s choice to ‘game’ is more influenced by differences in their learning software, and responses to boredom and confusion than to more long term factors such as their attitudes towards maths. This work in turn leads to the development of more effective learning software that can adapt effectively and sensitively to differences between students.

Meanwhile learning researchers at Dartmouth College in the USA have shown that, in spite of conventional wisdom, passive learning imprints on the brain in just the same way as active learning (Cross, 2008). They found that people can acquire motor skills through ‘seeing’ as well as ‘doing’. Using a video game where players have to move in a particular sequence to match the arrow on the screen, the researchers measured participants’ skill levels for sequences that were actively rehearsed every day, and for a different set of sequences that were passively observed for the same amount of time. Brain activity was measured using functional Magnetic Resonance Imaging (fMRI). The data were collected before and after five days of both visual and physical training, showing there was common brain activity when watching the practised and observed dance sequences. The researchers suggest that considering this overlap between physical and observational learning at the brain level can improve therapies for people affected by physical or neurological injury.

In Singapore, a Centre for Educational Research and Application (CERA) has been established at Nan Chiau Primary School, in collaboration with the Learning Sciences Laboratory of the National Institute of Education, Nanyang Technological University. It is the first research centre in a primary school, and is designed to transform teaching and learning using information and communications technology (ICT). Through the centre, the school can coordinate and promote research, innovative pedagogy and teachers’ long term professional development. It is intended that the partnership between teachers and researchers will lead to critical insights into the uses of technology and enable research to be closely aligned to practice.
Whilst work in the learning sciences is increasing in Australia, the Department of Education and Early Childhood Development is keen to gather high quality evidence to inform policy and practice, and encourages a wide range of research methods to investigate its research priorities. The Department also encourages partnerships between practitioners and researchers. By working together, practitioners can focus on their practice and share it with researchers, while researchers benefit from a greater understanding of what goes on in schools and early childhood settings.

**Bibliography**


