Teaching and Learning: Research Briefing

Rosamund Sutherland, Peter John, Susan Robertson

Teaching and Learning RESEARCH BRIEFING

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Using computers to enhance learning:
integrating ICT into everyday classroom practices

An important aspect of schooling is to enable students to enter new knowledge worlds, such as the world of history, of English, of foreign languages, of science, of music, or of mathematics. In the InterActive Education project we have worked in partnership with primary and secondary school teachers, to investigate ways in which information and communications technology can be used to enhance learning, with a particular focus on improving subject knowledge.

Schools have interpreted enthusiasm for Information Communication and Technology (ICT) in education as being about equipment acquisition.	→	Policy-makers and senior managers should prioritise support for teaching and learning with ICT in schools.
Effective teaching and learning with ICT involves building bridges between 'idiosyncratic' and 'intended' learning.	→	Personalised learning with ICT should focus on the construction of 'common' knowledge which has currency in wider communities outside school as well as in the classroom.
There is a two-way exchange of knowledge between home and school use of ICT. It impacts on learning in school.	→	Students should be encouraged to build on their out-of-school learning, whilst also bridging the gap between 'idiosyncratic' and 'intended' learning.
The teacher remains key to the successful use of ICT for learning.	→	Professional development needs to enable teachers to take risks with ICT and learning

The research

The InterActive Education project aimed to examine ways in which ICT can be used in schools to enhance teaching and learning. We took a holistic approach. We examined learning with ICT as it affects the learner and the whole class, and looked at the learner in settings outside school. We were careful to take into account the institutional and societal factors which structure learning.

The project was designed from the outset to bridge the divide between research and practice. At its heart was a partnership between university researchers, teacher educators and teachers. Ten schools and colleges from Bristol and South Gloucestershire and just under 60 teachers were partners in the research. They came from primary, secondary and further education.

The project was organised around Subject Design Teams (SDTs) in English, mathematics, science, modern foreign languages, music, history and geography.

Subject design initiatives

All of our interventions were developed at a local level, where a teacher and a researcher worked intensively together on the design, realisation and evaluation of a Subject Design Initiative (SDI).

These initiatives started out as simple ideas which exploited the use of available technology. Over time and with iteration they were transformed into powerful new uses of ICT for learning. The following examples illustrate this:

Learning to spell
10–11-year-old students used WordRoot, a multimedia sound and word package, and the presentation package PowerPoint, to analyse the structure and etymology of 'hard words'. Students' spelling improved, as shown by paper and pencil tests.

Learning to write in a foreign language
13–14-year-old students used drop-down menus in Word to support their writing in German. They wrote more in the foreign language and took more risks with grammar. Students' writing on paper was also enhanced after this exercise.

Learning statistics in the primary school
8- and 9-year-old students used spreadsheets and an interactive whiteboard to learn about frequency and the representation of data. This initiative centred on a whole-class investigation of the distribution of the colours of Smarties in a tube.

Learning mathematical proof
13–14-year-old students used dynamic geometry software and presentation software to learn about geometrical proof. They worked in groups and presented their work to the class for feedback on the validity of the proofs they had produced.

Learning to compose in music
Primary and secondary students used software to learn about composing in music.

Linking literature and Hypertext
17–18-year-old students made hypertexts to develop their understanding of intertextual relations in World War 1 literature. The importance of traditional reading practices was reaffirmed whilst the technology offered opportunities for student-centred knowledge creation and display.

Using computers for shared writing
9–10-year-olds in pairs composed an extra chapter of Alice in Wonderland, writing direct to screen. Analysis of pupils' interactions and writing suggests that the computer affords a more visual way of conceptualising the narrative voice and structure of a text than pen and paper. This challenges traditional notions of the writing process.

Understanding ICT as a tool for transforming learning

This project drew on socio-cultural theories of learning, which claim that all human action is mediated by tools. We interpreted the idea of a 'tool' to incorporate both digital and non-digital technologies.

The study emphasised that ICT is a multipurpose digital tool that can be used in the classroom to transform learning through:

- the development of radically new knowledge domains, which include multimedia literacies and web-based information systems
- providing access to knowledge domains that have previously been inaccessible to the majority of students, for example, composition in music, film-making, and 3-D design
- the simplification of complex knowledge domains through the speeding-up of normally time-consuming practices, for example the study of functions and graphs in mathematics, or of language change in linguistics
- the provision of digital tools as 'scaffolds' for particular learning aims, for example, dropdown menus to scaffold writing in modern foreign languages
- the creation of distributed on-line knowledge creation communities, as exemplified by Wikipedia.

Creative tension between 'individual and idiosyncratic' and 'intended' learning

We collected large amounts of video data, analysis of which shows that students can work with ICT for extended periods of time, investigating their own questions and experimenting with ideas in an interactive and iterative way. We have seen this whether students are learning about language and spelling, investigating the properties of quadrilaterals, developing their own compositions in music or writing e-mails to a German correspondent. But a tension is inherent in the power of ICT. We have found that extended individual engagement can lead to the

construction of idiosyncratic knowledge which is at odds with intended learning. For example:

- When secondary students were using the internet to learn about the Renaissance, some students spent time developing a project on Florence in the USA.
- When secondary students were using dynamic geometry to support their constructions of mathematical proof, many students started to use measurement instead of logical deduction.
- When primary students were investigating spelling rules using the WordRoot software, they sometimes constructed incorrect rules.

Constructivist views of learning have tended to assume that it is possible to move seamlessly from informal knowledge worlds into the more formal worlds of school knowledge in a self-guided manner. We disagree with this perspective. For example, without the support of a teacher students are unlikely to develop knowledge of mathematical proof from knowledge of everyday reasoning, knowledge of the Italian Renaissance from knowledge of popular culture, knowledge about the etymology of the English language from everyday experiences of speaking and writing English, or knowledge of science from game-like simulation software.

Effective teaching and learning with ICT involves finding ways of building bridges between 'individual and idiosyncratic' and 'intended' learning. Within successful subject design initiatives (SDIs) the teacher became aware of idiosyncratic knowledge construction and worked with the whole class to share, challenge and confront knowledge construction. This could involve students presenting their work to a critical audience, with the teacher commenting and directing. Here the interactive whiteboard, a projected computer image, or the non-digital whiteboard, are valuable (Godwin and Sutherland, 2004).

In many SDIs that were unsuccessful in delivering the intended learning, the teacher did not orchestrate a knowledge community. They seemed to believe that knowledge was embedded within the software and that ICT would somehow replace the teacher.

References

Godwin, S. and Sutherland, R. (2004) Whole class technology for learning mathematics: the cae of functions and graphs. *Education, Communication & Information* (ECi), 4 (1), pp. 131–52.

Ofsted (2004) ICT in Schools: *The impact of government initiatives*. London: Office for Standards in Education.

Major implications

Policy and management of ICT

The mandate for ICT in education has overwhelmingly been interpreted by schools as a licence to acquire equipment. This has been costly, but in addition, has detracted from teaching and learning. These institutional conditions make it difficult for teachers to incorporate ICT into teaching and learning. Policy-makers and senior managers should prioritise support for teaching and learning with ICT in schools.

Teaching and learning with ICT

The work of the Subject Design Teams supported teachers to take the risk of experimenting with ICT in the classroom. The majority (70 per cent) of teacher partners used ICT successfully to enhance student learning. This result is significant given overwhelming evidence from the UK and elsewhere that the vast majority of teachers are not using ICT to enhance student learning (Ofsted, 2004).

Analysis of video data also showed that students can work with ICT for long periods of time, investigating their own questions and experimenting with ideas in an interactive way. However, some young people engaged with ICT to learn things that were at odds with what the teacher intended.

Effective teaching and learning with ICT involves finding ways of building bridges between 'idiosyncratic' and 'intended' learning.

Teachers as enabled practitioners

Professional development needs to enable teachers to take risks with ICT and learning. The InterActive Project showed that a successful model for professional development is to create networked communities, in which teachers and researchers work in partnership to design and evaluate learning initiatives which use ICT as a tool for learning.

Such professional development requires people to break out of set roles and relationships, in which researchers are traditionally seen as knowledge generators and teachers as knowledge translators or users. For meaningful researcher-practitioner communities to emerge, trading zones are needed where co-learning and the co-construction of knowledge take place.

The capacity to engage in dialogue about implicit theories of learning and teaching, and a willingness to see them in the context of particular knowledge domains, were essential to the success of SDIs. The following quotes are illustrative of this:

It was encouraging …. we're all trying to work it through together. If you had a lot of experts going 'this, this, this and this and English and ICT works well in this particular way' I think this would be daunting to the rest of us.

(partner-teacher)

Working closely with my university partner and the whole team was without doubt the biggest influence on my learning. I was introduced to new subject knowledge and new theories of teaching and learning. I was reading new things on language, and research on language learning, as well as discussing ideas.

(partner-teacher)

Learners' out-of-school uses of ICT

The research found that teachers often underestimate the impact of students' out-of-school experience of ICT on the way they learn in the classroom. Analysis of data revealed the positive impact of contemporary and popular music on composition in schools, the use of search engines on language investigation in English, and experience of spreadsheets influencing how primary pupils learn data handling.

Home computer ownership and internet access were high, with 88 per cent of students from partner schools reporting home computer ownership and 73 per cent reporting home internet access in 2003. The home remains the main site for computer use outside school. The study also highlighted the two-way traffic between home and school in which young people passed on skills (such as PowerPoint) to their parents.

The first time I tried PowerPoint (at school) I really got used to it and I thought, 'This will be fun if I can show Mary (sister) and my Dad'. When I went home I said 'Dad, have we got PowerPoint?' and he had it, he never used to know what it was. So I had to go and show him everything, which took ages. He kept complaining, and then I said 'It's simple 'cos I know'.

These findings imply that teachers should encourage students to build on their out-of-school learning with ICT.

Further information

Further information, including articles, can be downloaded from the project website as below. In addition the following resources are available:

Publications for practitioners

Mills, S. (2004) Who's a Smartie? *Micromath* 20 (3), pp.17–23.

Weeden, M. (2002) Proof, proof and more proof, *Micromath* 18 (3), pp.29–32.

CD-Roms (available from mary.oconnell@bris.ac.uk)

Sutch, D. (2004) *A Thinking Approach to Spelling*. CD-Rom.

Mills, S. (2004) *Narratives of Learning: Developing tools for 'thinking together' about mathematics*. CD-Rom.

Olivero, F., Sutherland, R. and John, P. *It's about InterActive learning of mathematics*. CD-Rom.

Books

A TLRP Gateway book in the Improving Learning series is in preparation:

Sutherland, R., John, P. and Robertson, S. (2007) *Improving Learning with ICT*. London: Routledge.

The following book draws on the work of the mathematics Subject Design Team:

Sutherland, R. (2006) *Teaching for Learning Mathematics*. Maidenhead: Open University Press.

Refereed articles

A special issue of *Education, Communication & Information* (ECi), Vol. 4, No. 1 was published in August 2004 on the project.

The warrant

The InterActive Education Project was a collaborative partnership between the University of Bristol, a further education college, five secondary schools and four primary schools. The secondary schools were chosen so that their students represented a spread of socio-economic and ethnic backgrounds and their history of ICT use ranged from extensive to minimal. All had adequate ICT provision. Three of the primary schools were chosen because they fed into the secondary schools, while the fourth approached us to join the project. Fifty-nine teachers, seven researchers, six teacher educators and three research students worked together within the project.

Claims about teaching and learning with ICT centred on video case studies of Subject Design Initiatives, which captured the interaction between teacher and students and between the student and the computer.

Claims related to out-of-school learning with ICT were based on quantitative analysis of questionnaire data from all students in years 4, 7, 10 and 12 in the partner schools in 2001(N=1818) and 2003 (N=1471), focus group interviews with young people (N=192) on their out-of-school uses of ICT (2002), and case studies of young people using ICT in the home (2003).

Claims related to policy and management were based on discourse analysis of policy documents, qualitative analysis of interviews with senior managers in the partner schools, and quantitative analysis of questionnaires administered to teachers in all partner schools. Claims about professional development were based on qualitative analysis of interviews with project teachers and interactions within Subject Design Team meetings.

Project website: www.interactiveeducation.ac.uk
Project Directors: Rosamund Sutherland, Peter John, Susan Robertson
Project team: Dele Aboudrin, David Badlan, Rebecca Ball, Sally Barnes, Richard Brawn, Bryan Berry, Rob Beswetherick, Andrew Biggs, Chas Blacker, Adrian Blight, Helena Brazier, Nick Breeze, Linda Bridgeman, Natalie Butterworth, Chris Carter, Ruth Cole, Ellie Coombs, Roger Dale, Chris Davies, Tim Davies, Richard Eon, Keri Facer, Fern Faux, Marina Gall, Alan George, Marie Gibbs, Steve Godwin, Andrew Harman, Jo Heppinstall, Suzanne Houghton, Ben Houghton, Sally Jenkins, Judi Johnston Hubbold, Peter John, Pam Kelly, Naomi Kent, Linda Baggott LaVelle, Elisabeth Lazarus, Kerry Manley, Ross Martland, Sasha Matthewman, Angela McFarlane, Sam Mills, Simon Mills, Heidi Moulder, Federica Olivero, Pat Peel, Richard Rees, Sven Rees, Catherine Robertson, Susan Robertson, Andrew Rome, Emma Scott-Cook, Joe Sharp, Paul Stephens-Woods, Daniel Sutch, Rosamund Sutherland, Alison Taylor, Paul Taylor, Ian Thompson, Maria Thompson, Celia Tidmarsh, Neil Todman, Pat Triggs, Toby Tyas, Nigel Varley, Marnie Weeden, Paul Wilson, Jocelyn Wishart, Rachel Yates, Rachel Zewde
Project contact:
Professor Rosamund Sutherland
Graduate School of Education, 35 Berkeley Square, Bristol, BS8 1JA
Tel: +44 (0) 117 928 7108 **Email:** Ros.Sutherland@bristol.ac.uk

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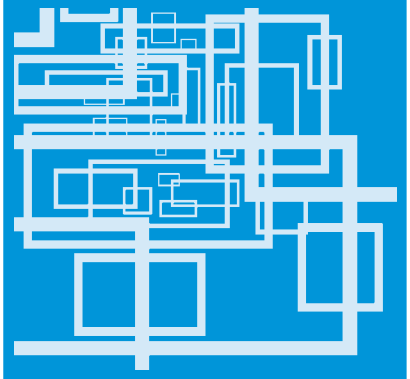
Teaching and Learning Research Programme



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TLRP Directors' Team
Professor Andrew Pollard | London
Professor Mary James | London
Professor Stephen Baron | Strathclyde
Professor Alan Brown | Warwick
Professor Miriam David | London
e-team@groups.tlrp.org

TLRP Programme Office
Sarah Douglas | sarah.douglas@ioe.ac.uk
James O'Toole | j.o'toole@ioe.ac.uk
tlrp@ioe.ac.uk

TLRP
Institute of Education
University of London
20 Bedford Way
London WC1H 0AL
UK

Tel +44 (0)20 7911 5577

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E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL