Symposium: Current and Future Issues in Research into ICT in Education


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Keywords: research methods, ICT, pedagogy, informal learning, curriculum, virtual worlds, educational transformation, envisioning, new learning outcomes, pre-service teachers

1. Objectives

This symposium has the following main objectives:
1. to examine key theoretical advances in research into the use of new technologies (ICT) in Education
2. to examine advances and issues in methods for researching ICT in formal and informal education
3. in the light of 1 and 2 to identify the main challenges and opportunities for researching ICT in Education over the next 10 years
4. to develop a position paper on issues relating to 1, 2 and 3 that emerge from the symposium

2. Background and Rationale

This symposium will build on the work of WG3.3 whose members have been working over several years to produce a book titled: Theory and History, Questions and Methodology: Current and Future Issues in Research into ICT in Education. This book, edited by McDougall and Jones is to be published during
2009. The book was conceived following concerns about a perception by some of a lack of a theoretical base for research into ICT and Education. Discussions about the book helped to crystallise our view that research into ICT in Education over 25 years had built on and developed theoretical perspectives from a wide range of research fields. Furthermore the diverse nature of developments in ICT in Education and their far-reaching effects and potential for change mean that whilst it is important for this research community to achieve coherence and identity it is also crucial to draw on research developments in other areas. The rapid developments in technologies and consequent opportunities and changes in education present many methodological challenges. The book provides a timely review of the research base of ICT in Education.

In this symposium authors of the book will present papers based on some of the key themes and questions that emerged from discussions about the book relating to the objectives above. In order to develop these themes and begin to address these questions these papers will draw on recent research with which the authors have been involved.

3. Structure

This half day (3 hour) symposium will contain 5 papers. The first 4 papers will be of 20 minutes each allowing 10 minutes for discussion of each paper. A further paper of 15 minutes duration will draw together key ideas and themes from the four papers, place them in a broader context with particular reference to the WG3.3 book and suggest issues for further discussion. The remaining 30 minutes will be used for discussion of emerging issues across the papers.

Between the 31st April and the conference an online discussion by members of WG3.3 will also discuss issues emerging from the papers. This will also enable the book editors (McDougall and Jones) who are unable to join us in Brazil to contribute to the discussion. Following the conference a position paper will be co-authored by the presenters.

4. Outline

The first paper by Cox reviews research into the use of ICT in formal and informal education focusing on research approaches and methods. The paper identifies current issues and future challenges by drawing on a range of previous studies and the work of some current research programmes. The second paper (Fluck) examines the beliefs of teachers and pre-service teachers concerning transformative uses of ICT. It describes the degree to which curriculum transformation was achieved through a process for envisioning transformed learning outcomes only realistically achievable by students using computers. The third paper reviews pedagogical models and examines how the use of ICT can
integrate into the models, change them or make them more complex. It draws on examples from recent research particularly in relation to formative assessment in pedagogical practices. The fourth paper (Twining) explores the potential of ‘open virtual worlds’ to be a new strategy for transformative educational research. The fifth paper (Bottino) will be a short response paper to the other four incorporating responses from a Web-based discussion prior to the conference and setting the scene for discussion in the symposium.

The first four papers are presented here as abstracts or short papers and will be developed into full papers by 31st April so that the online response paper can be drafted in good time for the conference.
Formal and Informal learning: research opportunities, challenges and issues.

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Abstract
The initial introduction of new technologies (ICT) in formal education settings in the 1960s and 70s was based on two main thrusts: meeting the need to provide a growing number of IT experts to work in the IT industry; and exploiting the potential for new technologies to enhance teaching and learning in other subjects (Rushby, 1983, Beauchamp, 2003, Cox, 2005). Even during the early uses in formal educational settings there was some access to ICT outside of schools as early as the 1970s with parents being encouraged to use stand alone computers with their children to further their education.

The early types of ICT resources used in formal settings was mostly educational computing software either based on tutorial style drill and practice programs following Skinner’s theory of programmed learning, or simulations based on Piaget’s constructivist learning theories which allowed the learner to investigate hypotheses and explore factorial relationships. Research into the effects of ICT was therefore mainly on the impact on learning in controlled settings (cf. Suppes, 1968, Bork, 1981, Merrill, 1975) using traditional methods to measure changes in learning before and after using an ICT resource and comparing the results with the learning of students being taught through traditional methods. (Marshall and Cox, 2007). Research results were often fed back into the design of the educational software being used.

Research into the impact of ICT in education has changed in focus and breadth over the last 40 decades as a consequence of these changing technologies and the focus of educators and policy makers on technological innovations in education (Voogt & Knezek, 2008, Cox, 2008). Increasingly young people have access to a wide range of digital technologies during their leisure activities as well as at school. In addition teachers and schools offer them new and varied opportunities for developing skills, understanding and expertise with new technologies. However, much of the research evidence to date of students’ informal uses of digital technologies (ICT) is about the frequency of use in different educational settings and the different types of ICT uses occurring amongst learners at school and in the home, little is known about the impact on their learning due to informal uses and the ways in which informal learning experiences will affect their learning in formal settings.
In the UK, biennial surveys conducted by the Department of Education and Science (now Department for Children, Schools and Families) have shown not only the changes in the level of ICT resourcing in schools which have taken place over a specific period, e.g. from 1985 to 2004 and how these have affected the actual uptake and use by teachers in schools but also more recently the relative access for pupils to ICT resources outside of school (Cox, 2009).

There have been a growing number of studies of the uses of IT by children in both formal and informal contexts. Yelland (2003) investigated 20 children's formal and informal experiences using computer games in mathematical contexts. She studied the ways in which children chose and evaluated computer software in the home and at school. This type of study using qualitative methods of observation and interviews is widely used by researchers of IT in education but has been criticised because of the limited applicability of the outcomes to the wider population of learners (Cox and Marshall, 2007). A larger study on young people's home and school IT use by Kent and Facer (2004) involved a questionnaire survey of 1800 children in South West England, interviews of 190 children and visits to 11 families. The focus of this study was on ICT use and not on the consequent impact on students' learning.

A more recent study of students’ informal uses of ICT conducted by Luckin et al. (2008) involved a survey of 2,611 Year 8 and Year 10 pupils (aged 14-16) and approximately 300 learners, who were categorised as a ‘Web 2.0’ sample of 12 schools selected to be representative of school environments in which Web 2.0 activity was flourishing. The research team found that the level of use of social networking sites was high for both groups, see Figure 1 below, and that “users of Web 2.0 technologies may be seen as operating on a continuum between individual-social and passive-active participation.” (ibid. p. 26).
The large body of 40 years of research evidence using a range of research methods has resulted in some common understandings of the affordances which different ICT types can provide for students' learning in both formal and informal settings (Voogt and Knezek, 2008). The table derived by Webb and Cox (2005) shown below (Table 1) shows that the potential beneficial impact of ICT on individual students' learning is very dependent upon the level of access, and furthermore upon the specific types of ICT use whether in school, university or at home. If we consider the great variety of affordances for learners in informal as well as formal settings then there are still many unanswered questions about the benefits to children of using ICT outside formal school settings. What is more widely known is that appropriate uses of ICT in schools can have a significant impact on students’ learning (Barton, 1997, Dori and Barak, 2001, Cox and Abbott, 2004, Lai, 2008) but that the effectiveness of ICT use in formal settings such as schools and colleges is very dependent upon the willingness and abilities of the teacher (Downes et al., 2001, Cox and Webb, 2004, Law, 2008).

A further major factor which makes researching ICT in education so difficult unlike many other educational changes is the ever changing technology itself which continues to be embraced under a single heading of "new technologies" or IT or ICT in education. The increasing access to ICT resources in informal settings not only results in a wider diversification of ICT uses by learners but also a greater variability in their digital literacies and an unknown variable which is the level of control of the learning activities as is shown in Table 2 below.
### Table 1  Affordances for students’ learning (Webb and Cox, 2005)

<table>
<thead>
<tr>
<th>1. Categories of affordances</th>
<th>2. Learning supported</th>
<th>3. Type of IT used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researching information</td>
<td>Acquiring knowledge, consolidating understanding</td>
<td>Internet, Web browsers, Web cams, Video conferencing, content-specific CD-ROMS</td>
</tr>
<tr>
<td>Preparing presentations and producing materials</td>
<td>Organising ideas, reflecting, reviewing, evaluating, consolidating understanding</td>
<td>PowerPoint,</td>
</tr>
<tr>
<td>Presenting</td>
<td>Presentation skills, organising ideas, reflecting, reviewing, evaluating</td>
<td>PowerPoint, Interactive Whiteboard,</td>
</tr>
<tr>
<td>Visually representing processes / ideas</td>
<td>Understanding dynamic processes</td>
<td>Simulations, animations</td>
</tr>
<tr>
<td>Feedback</td>
<td>Knowing what areas need more learning, Thinking, Predicting,</td>
<td>Simulations, Mind mapping software, Interactive Whiteboard</td>
</tr>
<tr>
<td>Changing variable values</td>
<td>Understanding relationships between variables, Predicting, Hypothesising</td>
<td>Simulations, Spreadsheets</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>Thinking, Linking ideas</td>
<td>Interactive Whiteboard, Mind mapping software</td>
</tr>
<tr>
<td>Redrafting</td>
<td>Organising ideas, reflecting, reviewing,</td>
<td>Word processors, Interactive Whiteboard,</td>
</tr>
<tr>
<td>Recording notes</td>
<td>Thinking about relationships</td>
<td>Word processors, Interactive Whiteboard,</td>
</tr>
<tr>
<td>Designing</td>
<td>Problem solving, Decision making</td>
<td>Control software</td>
</tr>
<tr>
<td>Making a drawing</td>
<td>Thinking about what they already know about composition</td>
<td>Drawing package</td>
</tr>
<tr>
<td>Taking turns</td>
<td>Social skills, sharing</td>
<td>Roamer, shared computer</td>
</tr>
<tr>
<td>Broadening experience</td>
<td>Generalising from examples, extending their ideas, classifying, generating new ideas</td>
<td>Internet, Web browsers, Web cams, Video conferencing</td>
</tr>
<tr>
<td>Drawing graphs</td>
<td>Thinking about relationships between variables</td>
<td>Spreadsheets</td>
</tr>
</tbody>
</table>

### Table 2  Technologies available to learners in different settings and level of control

| Teacher unsupervised Parental/guardi |
|--------------------------------------|-------------------------------|----------------------|

As a result of this ever-changing technology, new literacies (perceptions and understandings linked to new modes of presentation and representations) are changing the emphasis and the balance in terms of the production, content and meaning of educational resources, which is often not understood by teachers and researchers. This paper will review the wide range of technological changes which have taken place over the last 30 years and the affordances these provide and the consequent implications for research methods and issues regarding investigating the impact of ICT on formal and informal learning.

References


Towards Transformation: envisioning new learning outcomes for ICT

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Abstract: Information and communications technology (ICT) is central to educational transformation in several countries (AITEC, 2008; DfES, 2005). This perception is proving difficult to turn into reality (Reynolds et al., 2003) and research in the area has turned to factors facilitating or blocking such changes. This study is one of a series looking into the potential of ICT to aid transformation of content (curriculum) and pedagogy, the ‘what’ and ‘how’ of learning. It focused on the beliefs of pre-service teachers concerning transformative uses of ICT. For instance, there is considerable debate about the relative roles of handwriting, word processing and dictation in the early years’ curriculum. Therefore the problem becomes more complex, and teachers’ beliefs become central to the adoption paradigm. Several cohorts of pre-service teachers were inducted into a process for envisioning transformed learning outcomes only realistically achievable by pupils using computers. This report outlines the change process in which they were engaged, and describes the degree to which curriculum transformation was achieved.

Keywords: ICT, educational transformation, envisioning, new learning outcomes, pre-service teachers

1. Introduction

Research into educational innovation with ICT has found parallels with studies of change management in other spheres. These parallels may be important in the context of the Australian Digital Education Revolution (Rudd, Smith & Conroy, 2007), propelled by policy makers’ assertions that student learning outcomes will be improved by every student having computer access in school. However, there is contrary evidence that ICT does not improve conventional student learning outcomes (Dynarski et al., 2007; Robertson & Fluck, 2006; Cuban, 2001).

One way to avoid disputation about the effectiveness of integrated ICT is to speculate on the nature of a curriculum transformed by computer use. We have had debates about the introduction of new technology into schools (slates to quills
to biros; slide rules to calculators), but technological innovation has generally come into schools over time. New areas of enquiry and learning have been opened by computers, but these rarely move quickly into the school curriculum. Thus it seemed worthwhile to work with pre-service teachers as agents of change to modify their expectations of classroom ICT and thus expedite educational transformation. This paper describes a method for envisioning educational transformation mediated by ICT, in order that it may subsequently be researched.

The author thanks and acknowledges the contribution of participating students and colleagues in the course units mentioned in this paper.

2. Previous work

The idea of transformative approaches to the use of ICT in school education is not entirely new. Moursund (2002) talked about ‘getting to the second order’ and aspired to moving beyond mere amplification uses of ICT. ‘Amplification’ can mean the use of a word-processor to create a text which is more neatly printed than a handwritten one. A second order use would be consistent use of styles within a desktop publishing package to ensure automatic creation of indices, tables of contents, tables and figures etc.

David Perkins (1993) has also written about ‘person plus’, the idea that people with computers are able to undertake cognitive work beyond that which either (people or machines separately) could manage. A further ramification of this idea is the theoretical examination of the effect of computers-as-tools upon individual, social and conceptual development. For instance, widespread use of statistical tools such as ANOVA can be hypothesized as having affected the development of psychological theories (Salomon & Perkins, 2005, p.83). An additional thought worth mentioning is the idea of computer-supported collaborative work. Given the right kind of software, a group of individuals can effectively solve a difficult problem. 24/7 agile programming where teams around the world continuously work in unison to write new application code is an example, both commercially and for free and open source developments (Scacchi, 2007, p.263).

Bringing new concepts such as this into the classroom can be a challenge. Despite many technical innovations coming to market or being trialled in schools, only a few ever become accepted. This can be ascribed to social inertia, a force which is too frequently underestimated (Sinko & Kiesi, 2000, p.276). Nevertheless, the progression from studies of information technology, to ICT integration and thence to transformative uses of ICT has been described (Fluck, 2003) and mapped (Downes, Fluck et al. 2003, p.23) as follows:

• Type A: encouraging the acquisition of ICT skills as an end themselves;
• Type B: using ICTs to enhance students’ abilities within the existing curriculum;
• Type C: introducing ICTs as an integral component of broader curricular reforms that are changing not only how learning occurs but what is learned;
• Type D: introducing ICTs as an integral component of the reforms that alter the organisation and structure of schooling itself.

If we are to aspire to types C or D, then a pathway is needed from current practice to educationally transformative applications of ICT. Implicit in the framework is change of curriculum and/or pedagogy. Teachers are obviously crucial to either and therefore this project aimed to see if they could become involved in the change process. Pre-service teachers in particular have acted as agents of ICT-led change before. The Partnerships in ICT learning study (Pegg, Reading & Williams, 2007) used a Professional Learning Model to structure this approach (see Figure 1).

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Explore new knowledge — Involves partners in direct awareness-raising events about ICTs, curriculum frameworks, pedagogy or other relevant subject matter.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 2</td>
<td>Select a learning experience for students — This might be a unit of work, task, project or series of lessons where ICT is used to enhance the learning experience.</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Plan the learning experience — Develop the learning experience detail including the underpinning pedagogy.</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Implement the learning experience — This might occur in a range of environments and should involve the pre-service teachers working with the students.</td>
</tr>
<tr>
<td>Phase 5</td>
<td>Reflect and share — This reflection should occur on the data, findings and collaboration.</td>
</tr>
</tbody>
</table>

Figure 1: PICTL Professional Learning Model (Pegg et al., 2007, p. 25)

3. The envisioning process

The envisioning process took place in the context of a third-year Bachelor of Education course. A specific learning outcome for the particular course unit was for pre-service teachers to “facilitate and lead appropriate, equitable and responsible pupil use of information and communication technologies integrated into all areas of learning.” This was the focus of several lectures and tutorials at the start of the unit, providing a foundation of operational skills and pedagogical understanding upon which to build. For instance, the pre-service teachers were shown how to make a WebQuest and plan the integration of ICT into classroom practice. They explored curriculum software, assistive devices for pupils with special needs and evaluated online learning objects.

One outcome from this preliminary work was an understanding of a digital educational resource. Pre-service teachers were exposed to a range of digital educational resources, including CD-based software, downloaded software, online
learning objects, interactive web-sites, web search tools and video libraries included on the standard laboratory workstation computer image. They were also aware of different types of digital educational resource such as free and open-source software (FOSS), commercial software, closed and open content applications. The provision of a freely available virtual computer emulation on the University computers facilitated their experimentation with new software without compromising network security.

The main preparation for envisioning transformative uses of ICT was conducted using a five step process, modelled on the PICTL Professional Learning Model:

1. **Starting Out:** Work with a partner and identify a learning outcome in your subject area or discipline, and say which year group this is suited to. This should be specific, such as: calculate the area of a right-angle triangle.

2. **Integrating ICT:** Search in the eCentre or use another search engine such as Google to identify digital educational resources which will assist pupils’ achievement of this learning outcome. You should look for interactive resources which engage pupils.

3. **Extending with ICT:** Through discussion with your partner, decide what additional learning pupils could undertake with the aid of this digital educational resource. How does this extend what they could do?

4. **Transforming with ICT:** Re-conceptualise the initial learning outcome given the affordances of this digital educational resource. Write down a new learning outcome which:
   - Could only realistically be achieved through the use of ICT and/or
   - is at a higher cognitive level than the original learning outcome and/or
   - can be learned/taught in a different way to that implicit in the original learning outcome.

5. **Devise a teaching sequence for the new outcome:** What would be a good way to introduce pre-requisite skills? How can you, and your pupils, confirm they have mastered this new learning outcome?

Figure 2: Five-step envisioning process

The pre-service teachers engaging in the process were given a short example of a transformed learning outcome based upon use of an online learning object which simulates a bushfire (see http://www.shodor.org/interactivate/activities/Fire/).

In writing up their envisioning processes, the pre-service teachers were also required to outline why the new outcome was useful (to justify their choice). They described the teaching progression by which they would enable pupils to achieve the new learning outcome, and provided the exact wording of an assessment task for pupils to demonstrate achievement. Finally, they had to provide an example of
the kind of evidence they would expect from pupils and show how it would be assessed.

4. Outcomes

The envisioning process was carried out by five cohorts of pre-service teachers on three campuses over two years. Several staff of the Faculty were involved, and in many cases our expectations were surpassed by the pre-service teachers. The moderated assessments of the process for the five cohorts were as found in Table 1. This shows that there was a high level of attainment in the activity, accompanied by a high level of engagement.

<table>
<thead>
<tr>
<th>cohort</th>
<th>n</th>
<th>mean mark</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPC353-07</td>
<td>1</td>
<td>63</td>
<td>10.16</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPC353-08</td>
<td>1</td>
<td>60.79</td>
<td>15.42</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESA196-08-L</td>
<td>5</td>
<td>72</td>
<td>6.23</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESA288-07</td>
<td>3</td>
<td>70.96</td>
<td>16.65</td>
</tr>
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<td></td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESA196-08-H</td>
<td>8</td>
<td>72.53</td>
<td>14.02</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
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</tbody>
</table>

The comparison of contemporary learning outcomes and new outcomes (generated by the envisioning process) was of interest.

This process showed that in the main, cohorts of pre-service teachers could become confident that ICT can support deeper learning (using Bloom’s taxonomy or similar frameworks). We were interested by the sophistication shown by some pre-service teachers who stipulated an eclectic mixture of computer technologies rather than a single digital educational resource. For instance, one new learning outcome was predicated on pupil use of five ICT resources to “transfer accessible texts into an audio visual experience”:

- Microsoft Paint.
- PhotoStory.
- Kidspiration
- Audacity to make soundscapes
- Royalty-free sound bites eg: http://www.freesound.org/

Other examples appropriated ICT resources commonly banned from pupil use, demonstrating a paradigm shift on the part of the pre-service teachers. Rather than
spurning assistive writing software for interfering with the development of good literacy skills, one group based their new learning outcome on the software ComposeEssay 1.0 (from http://www.newfreedownloads.com/Home-Education/Teaching-and-Testing/ComposeEssay.html). The program creates a template for “compare and contrast essays”, using an ideas bank and brainstorming through an interview-like approach. This software was identified as the digital educational resource to help pupils “understand how to write original concepts and apply basic essay structuring skills to form ideas in a logical, cohesive way”. The essays by Year 10 (age 16) pupils were to be assessed according to their grammatical structure, comparative analysis and logical flow. Other examples of transformed learning outcomes are shown in Table 2.


<table>
<thead>
<tr>
<th>Curriculum area and Year group</th>
<th>Old learning outcome</th>
<th>Digital educational resource</th>
<th>New learning outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geography: Year 3/4 (age 8/9)</td>
<td>Explain why conserving resources is important for the environment</td>
<td>Dumptown (<a href="http://www.epa.gov/recyclecity/">http://www.epa.gov/recyclecity/</a>)</td>
<td>Identify how selected businesses reduce, reuse and recycle. Model the costs and benefits of the government recycling programs in “Dumptown” and judge which might be appropriate for our community.</td>
</tr>
<tr>
<td>Arts – Music: Year 4 (age 10)</td>
<td>Incorporate a range of musical elements (dynamics, tempo, texture, timbre, pitch) in their music, with some understanding of their musical purpose.</td>
<td>Live Lite 6 (compositional/recording software</td>
<td>Incorporate a range of musical elements (dynamics, tempo, timbre, pitch) in their electronically generated composition with an understanding of their musical purpose.</td>
</tr>
<tr>
<td>Arts – Music: Year 4 (age 10)</td>
<td>Begin to select and control instrumental and technical media used in producing pieces of music.</td>
<td>Rap Machine (The Le@rning Federation online learning object)</td>
<td>Put into practice rhythmic and aural skills using speech and beat patterns.</td>
</tr>
<tr>
<td>Communicating: Being Literate: Year 5 (age 11)</td>
<td>Understands how to select and use communications for different audiences, purposes and contexts</td>
<td>Languages Online (<a href="http://www.eduweb.vic.gov.au/languagesonline/default.htm">http://www.eduweb.vic.gov.au/languagesonline/default.htm</a>) Google Translate Google Earth ePals</td>
<td>Students will gain an understanding of the concept of global communities through the use of ICT to correspond bilingually in a variety of contexts to different audiences.</td>
</tr>
<tr>
<td>Maths: Year 6 (age12)</td>
<td>Calculate the area of a rectangle.</td>
<td>Excel Geometer’s SketchPad Google Sketchup</td>
<td>Calculate a skyscraper’s volume.</td>
</tr>
<tr>
<td>Science: Year 8 (age 14)</td>
<td>Plan and carry out investigations, that involve a small number of steps, using appropriate equipment, and following suggestions to collect, record and present data</td>
<td>MP3 recorders/players Audacity Mapping software e.g <a href="http://www.communitywalk.com">www.communitywalk.com</a></td>
<td>Use electronic recording devices to collect and record the unique identifying sounds of a bird species in a local habitat. Generate a map to display the distribution of the species.</td>
</tr>
</tbody>
</table>
5. Discussion and Conclusion

Some of these examples show an excellent understanding of the potential of ICT, and an acknowledgement that this potential will not be tapped if pupils continue to study within the confines of the ICT-less curriculum. For instance, to incorporate bilingual communication whilst acknowledging limited understanding of a foreign language seeks to build global understanding much more directly than would otherwise be possible.

Such a set of new learning outcomes will not be accepted without considerable controversy. However, this envisioning process gives policy-makers and educationalists the opportunity to select transformative approaches from a bank of ideas generated by teachers and deemed by these teachers as practical for classroom implementation.

Working with pre-service teachers to fulfil their expectations can lead to tensions if also equipping them for a rapidly changing technological educational environment. Whilst many pre-service teachers have appreciated the thrust of the course unit, others responded to a culminating survey with comments such as ‘keep to what is normally available in schools’.

This category of comment perhaps epitomises the challenges for research into educational technology. If research interest is restricted to the office-suite comprising the kernel of application software on many school computers, then opportunities to monitor pedagogical change will be limited. This article is not focussed upon the contested control of school workstation software deployments (see Fluck & Cruse, 2008) but understands infrastructure and working knowledge (Webb, 2007) are crucial to transformative developments.

This article has described a process by which pre-service teachers can obtain a perspective on educational transformation through ICT. The project leads immediately to two interesting questions. Firstly, can such an approach work with in-service teachers who have already spent time in a classroom context and whose livelihood depends upon a capacity to conform to externally imposed standards such as reporting accountability frameworks, curricula and mandatory standardised testing? Would the novelty of a transformative approach be viewed as educational advanced and institutionally supported, or would such a teacher be castigated for failing to provide an appropriate education?

Secondly, will pre-service teachers entering these same classrooms be any more able to introduce change than their colleagues?

Both these questions would be worthy topics for further research into the generation of curricula transformed by ICT.
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Changing models for researching pedagogy with technology

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Abstract

This paper takes as its starting point an analysis of models that have been developed for or applied to research into pedagogy for the use of Information Technology (IT) over the last 20 years (Webb 2009). These include models and frameworks developed to explore pedagogy in general (e.g. Shulman 1987; Alexander 1992; Engeström 1999; Webb 2002) that have been applied to pedagogy with technology (Webb 2002) as well as models developed specifically to understand and characterise the role of technology in pedagogy (e.g. Squires and McDougall 1994; Laurillard, Stratfold et al. 2000; Twining 2000; Koehler and Mishra 2005). This analysis (Webb 2009) identified the following important interrelated phenomena that have been and still are being researched using this range of models:

- Teachers’ pedagogy and pedagogical practices when using IT
- The affordances that various types of IT may provide for learning and teaching
- The potential for developing pedagogy with IT
- Current and future roles for teachers, students and the technology

The models analysed all have something to contribute to researching these phenomena through supporting specific research tasks as summarised in Table 1.

Table 1 Summary of specific research tasks for which models relating pedagogy and technology are required (Webb 2009)

<table>
<thead>
<tr>
<th>Task</th>
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<tr>
<td>Placing pedagogy in a broader context</td>
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<tr>
<td>Characterising computer use</td>
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<tr>
<td>Analysis of interactions between designers, teacher and students</td>
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<td>Quantitative analysis of computer use for specific learning purposes</td>
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<td>Identifying factors affecting teachers' and students' behaviours towards IT</td>
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<tr>
<td>Measuring and analysing the uptake and levels of use of IT</td>
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<tr>
<td>Analysing pedagogical practices and pedagogical reasoning relating to IT-use</td>
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<tr>
<td>Understanding the nature of knowledge developed through and required for pedagogical reasoning about the use of IT</td>
</tr>
<tr>
<td>Analysing and characterising systems that are undergoing change relating to IT use</td>
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<tr>
<td>Involving teachers and students in researching and developing IT use</td>
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Sfard (2008) some of these frameworks and models are more useful than others for understanding current and future changes in pedagogy and pedagogical practices.

Therefore key questions to be addressed in this paper are: how can existing theoretical frameworks and models help us in researching pedagogy and pedagogical practices in a world where learning opportunities are diversifying as a result of technological developments?, what are the limitations of existing models and how might these be addressed? The paper draws on several recent empirical studies of primary and secondary students as well as beginning teachers (Jared 2008; Ryberg and Christiansen 2008; Webb 2008; Webb and Jones 2008 (in press)) to examine the application of the frameworks and models.

Developments in understanding of cognition and meta-cognition have led researchers to develop a complex differentiated model of pedagogy that draws attention to the creation of learning communities in which knowledge is actively co-constructed, and in which the focus of learning is sometimes learning itself (Watkins and Mortimore 1999 Page 8). Ryberg and Christiansen (2008) for example in their analysis of peer-to-peer learning on a social networking site examined the relationship between “vertical and horizontal learning”. They adopted the notion of horizontal learning from Engeström’s “expansive learning” and Wenger’s idea of brokers moving between communities and spreading knowledge. Expansive learning is one of the principles of third generation activity theory (Engeström, 2001) and describes learning of new forms of activity. These do not yet exist so cannot be described in advance or taught but may arise through transformations in activity systems. According to Engeström (2001) expansive learning produces culturally new patterns of activity. Ryberg and Christiansen’s (2008) analysis showed how horizontal learning happens by crossing boundaries between several sites of engagement, and how the actors’ multiple membership provided access to a vast expanding distributed knowledge base. Thus they identified four modes of learning: individual-vertical; individual-horizontal; collective-vertical; collective-horizontal.

A complex landscape of relations and movements between these different modes of learning was identified in Ryberg and Christiansen’s study. Similar landscapes were identified from our studies of beginning teachers learning through collaborating on group projects (Webb 2008), from a study of teenagers learning to solve mathematics problems through seeking help from discussion fora (Jared 2008) and from our studies of peer interaction in primary classrooms (Webb and Jones 2008 (in press)). However our analyses suggest that while this framework characterises learning and knowledge construction in these collaborative learning situations it fails to address fully the processes of development as (opposed to learning) and how such development may be supported through teachers’ pedagogical practices (Webb 2009).

A clear distinction was made by Vygotsky between learning and development as explained by Chaiklin (2003 ). Development for Vygotsky means development of new psychological functions whereas learning consists of acquiring specific skills or applying psychological functions to new areas of knowledge (ibid).
Vygotsky’s notion of the zone of proximal development (ZPD) is important for identifying how teachers can support or enable development. By interacting with a child a teacher can identify the extent to which a child can solve a problem with support and compare this with other children of similar age. Thus the teacher can estimate the child’s ZPD and its size. This explanation of the ZPD from Chaiklin’s (2003) reading of Vygotsky, while not providing a complete account indicates the kind of interaction for diagnostic and formative purposes in which experienced teachers regularly engage. Such practices are also described by Shulman’s notion of “transformation” during the pedagogical reasoning process of the teacher (Shulman 1987) and by Perrenoud’s (1998) “interactive regulation” of learning. An important type of knowledge required for the pedagogical reasoning process is pedagogical content knowledge (PCK) (Shulman 1987). More recently Koehler and Mishra (2005) have examined knowledge required in technology rich learning environment and identified technological pedagogical content knowledge (TPCK) as an intersection between pedagogical knowledge, content knowledge and technological knowledge.

If learners are to be empowered to take full advantage of the new learning opportunities provided by new technologies the extent to which they are able to regulate their own learning needs to be incorporated into pedagogy. Models of self-regulated learning based on information processing theory have been developed and applied in a number of studies (see Greene and Azvedo 2007). However little research has been done on how children develop as self-regulated learners (Greene and Azvedo 2007; Dignath, Buettner et al. 2008). Involvement of learners in formative assessment holds some promise for development of self regulation (Black and Wiliam 2006). A framework developed from studies of pedagogical practices of teachers using technologies and from studies where formative pedagogical practices were embedded (Webb 2005) incorporated not only a pedagogical reasoning process of teachers but also one for learners.

In conclusion models and frameworks for researching and analysing pedagogy and pedagogical practices in technology rich learning environments need to take account of a range of phenomena, which cross various fields of research. These phenomena include “vertical” and “horizontal” axes of learning; models of children’s development of cognition and self-regulation; teachers’ pedagogical decision making and the range of knowledge types that these processes depend on.

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"Assessment in Education: Principles, Policy & Practice."
Do ‘open virtual worlds’ offer a new strategy for transformative educational research? A perspective from the Schome Park Programme.

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Abstract: This paper explores the potential of ‘open virtual worlds’ to be a new strategy for transformative educational research. The term ‘open virtual worlds’ is defined and ‘disruptive innovation theory’ is introduced briefly. The way in which Teen Second Life™ virtual world has been being used within the Schome Park Programme is then described. This leads to a consideration of the key features of ‘open virtual worlds’ which make them a new, transformational research strategy.

Keywords: research strategy, open virtual worlds, Second Life™ virtual world, schome, transformation

1. Introduction

The Schome Park Programme (SPP) used Teen Second Life™ virtual world (integrated with a wiki and forum) to provide participants with a ‘lived experience’ of a radically different approach to education compared with ‘traditional schools’. This paper suggests that the research strategy used within the Schome Park Programme provides a new model of educational research, which has the potential to transform education.

There are two strands to this: one relating to features of ‘open virtual worlds’ (Twining 2008a) and the other to ‘disruptive innovation theory’ (Christensen, Horn and Johnson 2008). This paper provides a brief explanation of ‘open virtual worlds’ and ‘disruptive innovation theory’ before going on to look at how an OVW (Teen Second Life™ virtual world) was used within the Schome Park Programme. This will lead to an exploration of the potential of OVWs to enable a new strategy in educational research that has the power to transform education.
1.1 Open Virtual Worlds (OVWs)

Twining (in press a) contrasted ‘open virtual worlds’ (such as Second Life™ virtual world) with what he called ‘restricted virtual worlds’ (such as World of Warcraft) and suggested that open virtual worlds (OVWs) “offer opportunities for people to have radically different ‘lived experiences’ of educational systems and thus seemed to be the ideal vehicle for exploring alternative models of education” (p.1).

Open virtual worlds (OVWs), such as Second Life™ virtual world, are online applications in which users, represented by an avatar, have the facilities to interact with each other and create their own environment using open ended tools. They differ from Restricted Virtual Worlds, such as World of Warcraft, in that they are not designed with specific missions/goals in mind and the environment that users create is not pre-scripted (and thus constrained) by the application’s designers. The technical limitations on what a user can do within an OVW are due to the sophistication of the building and scripting tools provided and the user’s competence in using them.

There are three key aspects of OVWs that underpin their potential to provide a new strategy for ‘transformative educational research’:

- OVWs allow participants to do things which it would be difficult or impossible to do in the physical world – both literally and pragmatically. Pragmatically it would be more difficult and expensive to set up a new learning community in the physical world than in a virtual world. Literally, there are things you can do in virtual worlds that are not possible in the physical world, such as flying like a bird (without even having to flap your arms). (Twining 2007)

- Our experiences of OVWs suggested that they encouraged experimentation, playfulness and breaking of physical world conventions. For example, the way in which avatars behave and interact in meetings in OVWs tends to be much more informal and fluid than in similar meetings in the physical world (Twining & Footring 2008). This reflects de Nood & Attema’s (2006 p.20) view that in virtual worlds participants “are freer to play out their personal preferences without being constrained by established roles and behavioral expectations”.

- OVWs provide new forms of representation and interaction with your (virtual) environment. For example, when setting up a shop in an OVW storage space is not an issue as any item can be represented by its name in an inventory list. The object ‘materialises’ in the virtual environment when activated but can be reduced back to its name in a list with the click of your mouse. Similarly, buildings take on a different significance in an OVW because they no longer serve physical world purposes such as protecting you from the elements, or providing a structure in which to locate furniture (a display board doesn’t need to be attached to a wall in an OVW as it can float in mid air if you wish). (Twining & Footring 2008)
1.2 Disruptive innovation theory

The use of ICT in education has a history going back to the early 1970s. This is mirrored by research looking at the impact of ICT in education and the issues surrounding the effective implementation of ICT in education. Underpinning much of this activity has been a focus on ICT as a catalyst for educational change (or even transformation). However, the level of integration of ICT into education still appears to be minimal, with, for example, students making greater use of ICT outside school than they do inside it (OECD 2005). Indeed, there is little to suggest that ICT is helping to bring about the sorts of transformations identified in the rhetoric around ICT in education (e.g. DFES eStrategy (DfES 2005)).

Part of the explanation for this is due to the complexity of education systems. Current education systems were set up in an industrial era and their underlying structures and procedures were designed to meet the needs and understandings prevalent at that time. There are so many interdependencies within an education system that they are very stable systems. In order to bring about radical change you have to change almost everything at the same time, and that is very difficult to do within an existing system.

Christensen, Horn and Johnson (2008) provide an alternative model for transforming our education system to move from what they describe as a ‘standardized’ to a ‘student-centric’ approach. Their model of transformation is based on ‘disruptive innovation theory’. In essence this identifies that for a disruptive innovation to be successful it has to compete in a different plane of activity to the existing model, in which different criteria for success apply.

2. Overview of OVW use in the Schome Park Programme

The Schome Park Programme (SPP) set out to give participants a lived experience of a radically different form of education system compared with traditional schooling, in order to extend thinking about schome (the education system for the learning age).

In March 2007 149 students aged 13 to 17 were given access to Schome Park, an island in Teen Second Life™ virtual world. The environment was designed around four ‘curriculum’ areas: ethics and philosophy; physics, archaeology; and self-directed activity. The first three of these had designated ‘teaching areas’ and were led by academic specialists in the subjects. The self-directed activity was supported by staff, and focused on students building in the air above Schome Park. The ethos within Schome Park was one in which all participants were treated as equals (notwithstanding the differences in power between system administrators and other participants), and indeed information about the people ‘behind’ the avatars was concealed; thus, for example, nobody (including staff) knew the real names, genders or ages of other participants. This was a time of experimentation.
in which participants (of all ages) were encouraged to work together (rather than individually) and to try out ideas and learn from their mistakes. Towards the end of Phase 1 problems were arising due to the technical limit of the island to support all the buildings that had been created. Thus discussions started about how the community could organise itself in order to address this and any other problems that might arise. Phase 1 of the project ended in April 07 at which point the island was totally re-developed in order to take into account the increasing understanding about how to use OVW's most effectively.

In June 2007 Schome Park re-opened. The island had been redesigned so as to remove the designated teaching areas and provide a naturalistic environment with the students taking responsibility for its management and governance. Staff effort was refocused on supporting student-led activity and leading the production of a machinima (in-world movie) of 'the real story of the Hindenburg disaster (which can be seen at http://schomepark.blip.tv/ - select AirShip Hindenburg (Final Version)). Around a quarter of the students from Phase 1 carried on into Phase 2, where they were joined by approximately 40 new students. The ‘government’ devised and implemented new planning regulations in order to avoid the problems experienced in Phase 1 due to the level of building activity. This had the (unintended) effect of reduced the number of students involved in building activities. However, a large number of other activities were organized by the students (with varying levels of adult support), such as: a regatta which took several weeks to prepare and organise and culminated in a weekend of races; the creation of a funfair; work on chatbots; informal gatherings which often ended with a dance (with streamed music and disco lights). Phase 2 was dominated by the ‘core students’, most of whom had also taken part in Phase 1. The level of building and experimentation was constrained by the well intentioned bureaucracy introduced by the government.

Between mid-December 2007 (the end of Phase 2) and mid-January 2008 (the start of Phase 3) Schome Park was again re-developed in order to build on the lessons from Phases 1 and 2. An extra island (Schome Park beta) was purchased and set up adjacent to the original island (Schome Park alpha). One third of Schome Park alpha was turned into a sandbox (where anyone could build without needing planning permission). The students took responsibility for managing the rest of Schome Park alpha, whilst staff managed Schome Park beta. Part way through Phase 3 the control of the islands was changes to that parcels of land were allocated to groups of participants who had a specific project they wished to work on. In Phase 3 the focus on student led projects continued, with high levels of activity from the core group. For example, one student developed a racetrack equipped with a range of vehicles, starting lights and crash barriers, which was frequently used by other students to hold informal race meetings. Staff-led strands of activity were re-introduced. For example, one member of staff ran a strand called ‘Savvy Avvies’ in which participants created creating clothing and accessories for their avatars and/or to support other projects (such as the Time Travelers who needed togas). Two groups of students, coordinated by members of
staff, also entered national competitions, which involved a great deal of work over a prolonged period of time. Phase 3 could be characterized as involving a shift towards supporting groups of students who were committed to specific projects (often with some external constraints).

The SPP has led to the development of a series of ‘dimensions of practice’ that are powerful tools for thinking about the design of educational systems (for more details see: Twining, in press b; Twining, in press a; Twining and Footring 2008). It has also demonstrated the power of virtual worlds to create a vibrant learning community, which is evidenced, for example, by the high levels of interaction with and contributions to the wiki and forum that were integrated with Schome Park: the wiki and forum between them have had over 75,000 edits/posts (the wiki and forum can be accessed via http://www.schome.ac.uk/).

3. A new transformational research strategy?

3.1 A new research strategy?

The use of Schome Park, integrated with the wiki and forum, represents a new educational research strategy, which merges features of case study and quasi-experimental design.

The Schome Park Programme has allowed a ‘complete learning environment’ to be established in which a number of variables (such as the nature of the student-staff relationship; the content of the curriculum; control of the curriculum; the design and organization of the space in the environment; the nature of support provided) were managed (and in some cases varied over the course of first three phases of the programme).

Data collection included the use of chatlogs (i.e. transcripts of what people said when they were in Schome Park). This is a form of participant observation, which at first sight appears to fit Bryman’s ‘complete participant’ role (see Figure 1). However, there are two key distinctions:

- in Schome Park the researcher (who may be a student or member of staff) would normally be participating fully in an activity but would none the less be identified as an observer because they would be required to have a sign over their head saying ‘Logging chat’ for ethical reasons.
- despite being a ‘complete-participant’ they would be collecting a full transcript of everything that was said (within their hearing) even if they were not listening to what was being said at that time (so the transcript is not selective in the same way that a set of participant observer notes would be).

Data collection might also include snapshots (in-world photographs) or machinima (in-world films) in a way which is far less intrusive that the physical
world equivalent would be (though again, for ethical reasons the researcher should always have explicit permission to collect data in this way).

1. **Complete participant** – the observer is participating directly in the activity with a small group, interacting and being fully part of what is going on. It is not obvious that an observation is taking place. The observer is behaving naturally and normally.

2. **Participant-as-observer** – the observer is a part of the larger group, for example, a classroom, is actively involved and known and has a rapport with the group being observed. She is participating to a slightly lesser extent than the complete participant.

3. **Observer-as-participant** – here the observer is taking even less of a direct part in the events or activities being observed, and observing at the same time, without really being part of the small group activity or event being observed.

4. **Complete observer** – here the observer is observing from a distance and tries not to take part in the activity at all. She remains as detached as possible and conducts a more ‘formal’ style of observation. The observer does not interact with those being observed. She is a marginal participant or a ‘fly on the wall’. The fact that the observer is an observer is clear.

**Figure 1: Bryman’s (2001 p.298) four distinct participant-observer roles**

One of the potential dangers of using OVWs in research is the ease with which data can be collected covertly and the potential thus exists for unethical practices. Within the Schome Park Programme BERA’s revised ethical guidelines are strictly adhered to (BERA 2004). All participants are aware that they were taking part in a research project and have given express consent for their data to be used. They also know that they have the right to ask for any or all of their data not to be included in the research, without having to explain or justify their decision. In the case of the students their parents also sign informed consent forms.

OVWs also raise issues about the rights of avatars. The view taken within the Schome Park Programme is that avatars deserve the same ethical protection as the person who they represent. Thus, for example, in the same way that we would anonymise the names of participants in writing up ‘physical world’ research we anonymise the names of avatars when writing up research within the Schome Park Programme.

### 3.2 A transformational strategy?

Using OVWs in the way that the Schome Park Programme has done fits well with ‘disruptive innovation theory’. The facility to relatively easily set up a complete learning community, drawing in participants from across the globe, is critical as it allows you to operate alongside existing formal education systems, but without being constrained by them. Thus, for example, within the Schome Park
Programme, the student participants in Phases 1 and 2 were all operating outside formal school time and in a voluntary capacity. The criteria for success were radically different from those evident within formal school contexts, for example relating to:

- levels of participation, which is a requirement in formal schooling in the UK and the USA,
- depth of engagement, which is often overlooked within formal schools
- the development of ‘knowledge age skills’ which whilst recognized as being important in formal schooling takes a subordinate role to ‘curriculum content’ (not least because of the assessment regimes operating within formal education).

4. Conclusions

The Schome Park Programme has shown that OVWs can be used relatively quickly and easily to create learning communities, within which a range of variables can be managed in a way that would be impossible within the physical world. It has explored some of the methodological issues relating to the use of OVWs, which make them potentially powerful research tools. In so doing it has highlighted and found ways to address some of the particular ethical challenges that OVWs present to educational researchers. Whilst the Schome Park Programme has a long way to go before it can claim to have transformed education, it has demonstrated the potential of OVWs for developing thinking about education in powerful ways, which align with ‘disruptive innovation theory’ and thus maximize the possibilities for transformational change in education.

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