ALT-C 2010

"*Into something rich and strange*" – making sense of the sea-change

Conference Proceedings

www.alt.ac.uk

Acknowledgements

Production editing by Louise Ryan, ALT

Produced with the assistance of Melanie Fox, ALT and Oxford Abstracts

Design by Lucy Saxton
Cover design by Lucy Saxton
Printed by Nuffield Press

Your name (2010). Your paper title. In, Creanor, L., Hawkridge, D., Ng, K., Rennie, F. (Eds). "*Into something rich and strange*" – making sense of the sea-change. The 17th Association for Learning Technology Conference (ALT-C 2010). Held 7–9 September 2010, University of Nottingham, England, UK

ALT: registered charity, no. 1063519

ISBN 978-0-9566312-0-6

This document is available online at: repository.alt.ac.uk/797

Editorial

As noted in last year's editorial, the research strand of the conference is gradually evolving into a broader, perhaps more representative collection of papers which encompass not only research outcomes, but also informative case studies, approaches to strategic change and early findings from ongoing projects. However, the criteria for acceptance remain high: therefore it is particularly pleasing to see a significant increase in the number of papers accepted for publication in this volume.

Collaborative learning and team-working have emerged as key themes. This is apparent in Bitter-Rijpkema and Verjans account of supporting professional learning networks for knowledge workers through a hybrid approach of virtual learning environment plus Web 2.0 applications, and in Whatley's case study of students' use of a bespoke software system to support team projects in information systems. Similarly, Ferguson, Clough and Hosein describe how blogs can promote a sense of community for postgraduate research students, while Neumann et al highlight the benefits and challenges of using Google Docs to support collaboration among diverse groups of academic staff, administrators and students across six higher education institutions.

The increasingly important educational role of mobile devices is also strongly reflected here. Among authors who address this topic, Adams et al focus on a combination of mobile and 'tabletop' devices to support collaborative learning for geology students in the field and the classroom, and Bradley and Holley describe the results of an ongoing longitudinal study of mobile phone use by first year business studies students. Similarly, Cochrane and Bateman evaluate the impact of mobile learning across all three years of an undergraduate product design programme; and Dunne, Taylor, Potter and Wren report on improved group cohesion and quality of student work following the introduction of camcorders to support group work for management students.

The student experience is again emphasised by Hollins and Perry in their focus on student lifecycle relationship management and by Hu and McLaughlin in their account of computer-aided essay marking for first year biology students. Mostert and Snowball meanwhile provide a detailed evaluation of use of the Moodle Workshop module to support online peer assessment for a large cohort of first year economics students. Virtual worlds are explored by Rodman, Lavelle, Salmon and Cashmore who discuss the impact of an 'in-world' laboratory induction in genetics, and Barker, who reports on computer science students' comparative views of virtual worlds, managed learning environments and real world learning experiences. Stelmaszewska, Wong, Barn and Bhimani highlight the outcomes of a study of electronic resource discover systems, identifying the benefits and challenges of such systems from a student perspective.

Reflecting the staff viewpoint, James and Tynan critique the potential of Web 2.0 technologies to support knowledge transfer amongst academics, researchers and professionals, while Robson and Kennedy identify how teachers can be supported to make best use of tablet PCs for interactive learning activities. The importance of professional development as a means of embedding new practices is acknowledged by Scudamore and Arici through their mentoring model for e-learning, and by Clayton who provides a reflective account of the impact of a cluster model for professional development in ICT which has been implemented in schools across New Zealand.

The internationally-authored papers in this collection illustrate both the richness and strangeness of the conference title through their diversity of pedagogical approaches and innovative, even 'other-worldly' applications of technology to a variety of educational contexts. Making sense of it all is indeed paramount if we are to ride the waves of the socio-technical, cultural and economic sea-change in a way that benefits our institutions, our academic colleagues and most importantly, our students.

Conference Proceedings Editors
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The provision of professional development in ICT: a New Zealand perspective

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Over the last two decades there have been significant increases in the integration of Information Communication Technologies (ICT) in New Zealand schools. Investment in infrastructure, equipment and applications has been supported by a corresponding increase in the funding for Professional Development (PD) provision for teachers in ICT. This is based on the assumption that the level of competence and confidence of teachers in ICT directly impacts on the capacity and capability of schools to positively engage their learners in ICT-supported learning environments. Influenced by the school reforms of the late 1980s (Tomorrow's Schools) a school-administered model of professional development, the ICT PD Cluster Model, was conceived by the New Zealand Ministry of Education in 1996. This model encouraged groups of schools (clusters) to reflect upon the potential impact and influence of ICTs on their learning communities. The outcome of this process, combined with schools' existing knowledge of their teachers' capabilities and confidence in ICT, influenced decisions on the focus, design, delivery and assessment of professional development activities. The dual purpose of this paper is to firstly, review the ICT PD cluster model and describe those key features that could be considered 'best practice' and secondly, identify those attributes that either enabled or impeded ICT PD Cluster implementations and the critical organisational and operational success factors which should be followed in any future model of ICT PD implementation.

Keywords: *schools, professional development, responding to change, changing environments, peer support, mlearning, Web 2.0, case study, implementation strategies*

1. Background

Information and Communication Technologies (ICTs) have become an integral part of personal, societal and working life. ICTs extend from computers in homes, offices and schools, to personal portable devices and mobile technologies to the centrally-connected systems in businesses, banking and governments (Clayton 2009). The growing prevalence of ICT has prompted concerted government action (Becta 2009). There is an underlying assumption that governments need to ensure all their citizens are comfortable with, and capable of, using the ICTs necessary for them to successfully participate in an information-rich, knowledge-based, globally-connected, digital world (Lallana 2004). The education sector is generally aware that web-browsers are growing in sophistication and complexity, matching the increasing speed and differentiation of Internet search engines. There is increased availability of educationally-focused digital resources and growing use of media-rich content. Portable and mobile devices are becoming increasingly connected. Learners are obtaining ever-advancing technological skills. The combination of these means that learning events, for the school, learner and the educator, are less likely to be confined to text and print-based materials. Opportunities are being created to use ICT resources, time, place, and space more effectively (Clayton, Elliott & Saravani 2009).

2. New Zealand context

To participate successfully in the 'information age' and increasingly globally-connected learning environments, individual New Zealand schools and successive Governments have increased their investments in ICTs (Ham, Gilmore, Kachelhoffer, Morrow, Moeau, & Wenmoth 2002). This investment in infrastructure, equipment and applications has been matched by a corresponding increase in the funding for professional development provision for teachers in ICT. This move acknowledges that the level of competence and confidence of teachers in the educational use of ICT directly impacts upon the capacity and capability of schools to positively engage their learners in ICT-supported learning environments (Becta 2009; Clayton, et al 2009).

Initially, the ICT professional development offered to New Zealand teachers followed conventional models and modes of provision. In essence, a nationally perceived need (i.e. teachers' lack of personal ICT skills) was centrally addressed. This was achieved by either, the creation of professional development activities, provided within a defined timeframe and facilitated by external experts, or, by the funding of Advisory Services to employ IT specialists to provide guidance to individual schools (Ham, et al 2002). Influenced by the school reforms of the early 1980s and the devolvement of some operational responsibilities from central agencies to self-governing Boards of Trustees, a school-focused model of professional development was introduced in 1996. This was the Information Technology Professional Development (ICT PD) initiative (ICT Strategy Reference Group 1998). The enthusiastic response by participating schools to the ICT PD initiative encouraged the Ministry of Education to refine and expand this initial scheme. The result was the establishment of a professional development model that became known as the *ICT PD Clusters Model.*

3. ICT PD Cluster Model

The ICT PD model encouraged groups of schools (clusters) to reflect upon the potential impact and influence of ICTs on their learning communities and stakeholders. This reflection aimed to assist schools in identifying why, when and how ICTs would be integrated within their current practice. This identification, coupled with schools' existing knowledge of their teachers' capabilities and confidence in ICT, would influence school decisions on the focus, design, delivery and assessment of professional development activities (Clayton, et al 2009a). Although each cluster designed their own sequence and focus of professional development activity within the cluster, the basic structure of the ICT PD model was centrally prescribed as follows (Ham, Toubat, & Williamson-Leadley, 2005):

- The programmes developed were to focus on the integration of ICTs into the professional practices of teachers.
- A 'Lead School' would take responsibility for the collaborative partnerships with other schools and for the facilitation of teacher professional development for a period of three years.
- Each lead school would administer the funding allocated and ensure it was allocated to teacher professional development and no other purpose.

The intended outcomes of the ICT PD Clusters programme were:

- Increased understanding by teachers, principals, students, and school communities of the educational benefits of ICT;
- Increased capability of teachers and principals to use ICT for their own professional learning and to use ICT to facilitate improvements in student learning and achievement;
- Strengthened professional learning communities and increased collaboration within and across schools, and
- The development of a rich resource of expertise, experience, and materials in effective ICT use at a local and national level.

It was envisaged the success of these schools would promote good practice in other schools by being "exemplars" that could be used to inform the professional practices of other schools.

4. Models of professional development: deficit and empowerment

The views held by constructivists have significantly influenced the way professional development is conceptualised and delivered (Posner, Strike, Hewson, & Gertzog 1982). The separation between knowing and doing, described by the folk categories of 'know what' and 'know how' (Brown, Collins & Duguid 1989) can no longer be sustained. A foundational premise of constructivism is the concept that knowledge is actively constructed by the participant, not passively received from the environment in which they are placed (Driver 1989). To put it simply, it appears impossible to transfer competencies and concepts of ICT in education wholesale into teachers' heads and expect these to remain intact or unaltered. Teachers' perceptions that they can, or cannot, effectively use technologies in teaching and learning will impact on their ability to integrate them in their practice (Abbitt & Klett 2007; Niess, 2006). In short, the presentation of pre-packaged ICT learning events to teachers does not necessarily mean understanding will occur.

In the initial professional development designed for New Zealand teachers, external experts delivered preconceived learning events to specifically address their understanding of the identified deficiencies in teachers' knowledge (Ham, et al 2002). This did not fully acknowledge that teachers held views of teaching and learning and ICT that would be resilient and resistant to change (Abbitt & Klett 2007; Gilbert 1993). This centrally controlled broadcasting of learning events followed what could be considered a 'deficit' model of professional development (Clayton, et al 2009a). This is representative of a training or transmission model which aims to fill perceived gaps in the teachers' knowledge of ICT and its use, rather than a reflective practice approach which enables a degree of empowerment for the teacher to decide how the professional development is planned and structured (Niess, 2006; Smylie & Conyers 1991). The deficit model, where the expert fills the perceived gaps in a teacher's knowledge, is illustrated in Figure 1 below.

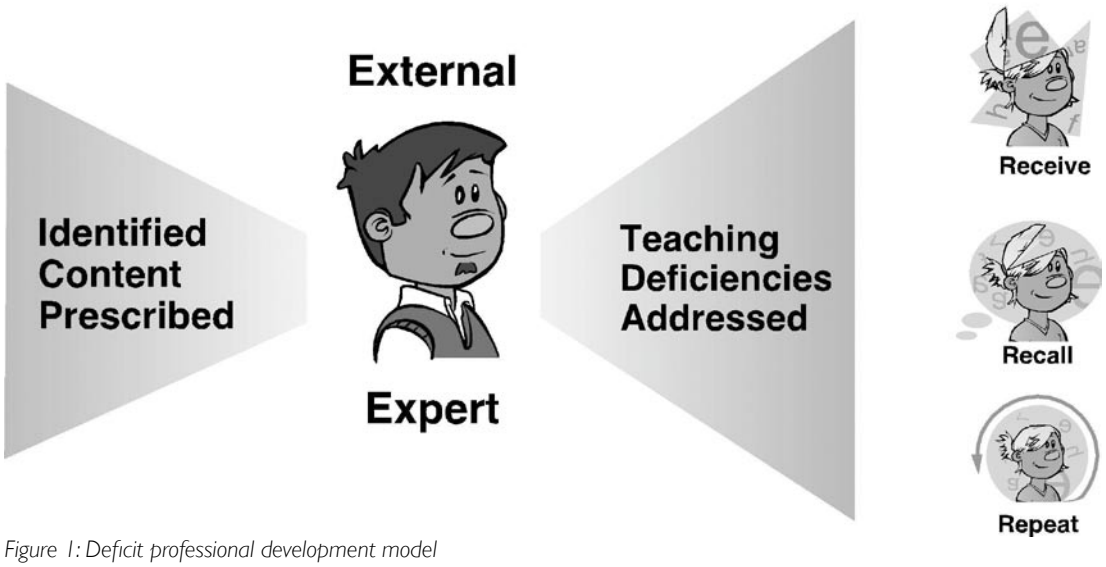

Figure 1: Deficit professional development model

The ICT PD cluster model encouraged groups of schools to reflect upon teachers' capabilities and confidence in ICT, their current practices, plus the potential impact of ICTs on their teaching and learning practices. In essence, the introduction of the ICT PD initiative shifted investment in professional development by schools and government from funding a 'deficit' approach to an 'empowerment' approach (i.e. schools' internal reflection and decision making on how, when and why ICTs could be integrated drive the creation, provision, timing and content of school-focused professional development), (Clayton, et al 2009a). This model of professional development would involve opportunities for teachers to share their expertise, co-learn with peers, and collaborate on authentic, "real-world" projects (Vrasidas & Glass 2010; Robertson, Fluck, Webb, & Loechel, 2004). This 'empowerment' approach, where teachers are encouraged to reflect on their current ICT practice, is illustrated in Figure 2.

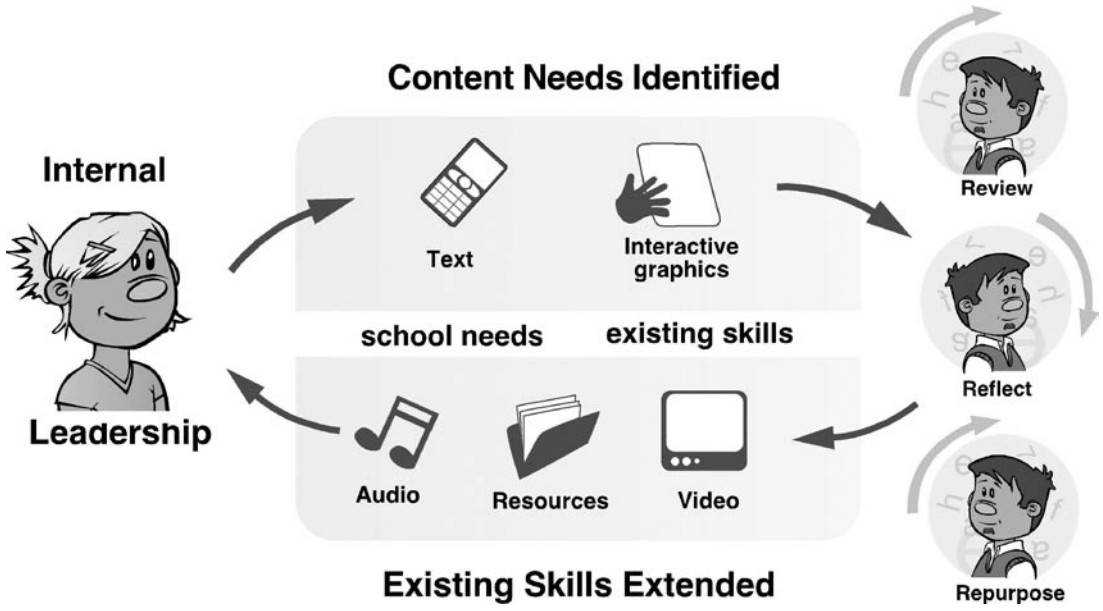

Figure 2. Empowerment model of professional development

5. National facilitation

The innovative shift from a deficit to an empowerment approach, meant that schools took ownership of the professional development process (Keller, Hixon, Bonk, &Ehman, 2008; Lawless & Pellegrino, 2007). This placed extra demands upon the school leadership. As well as undertaking their normal tasks, school leaders became responsible for the effective design and efficient delivery of school-focused professional development. This task was unanticipated when they were originally appointed to their roles. An identified risk inherent in this shift of approach was the ability of the existing leaders in schools to undertake the task of identifying and providing the appropriate professional development activities to meet the school's specific needs. In mitigating this risk, the Ministry of Education funded a national coordinator to assist school leaders to become familiar with the new tasks they faced. During the life-cycle of the project, this initial appointment was supplemented by appointments of other coordinators (Ham, et al 2005). For example, some of appointments focused on Maori, secondary, primary and/or virtual environments.

As well as providing assistance with administrative and contractual obligations national facilitation was intended to (Clayton, et al 2009):

- Aid the development of ICT strategic plans for individual schools.
- Provide guidance on cluster administrative tasks.
- Provide guidance on the likely effectiveness and efficiency of the ICT professional development being planned.
- Plan and provide activities that allow regular networking opportunities.
- Identify and disseminate 'exemplars' of good practice to inform the professional practices of other schools.
- Promote the creation of 'communities of practice' around the implementation of ICTs in teaching, learning and administration.

The national facilitation, conceptualised as a 'ripple model', is illustrated in Figure 3.

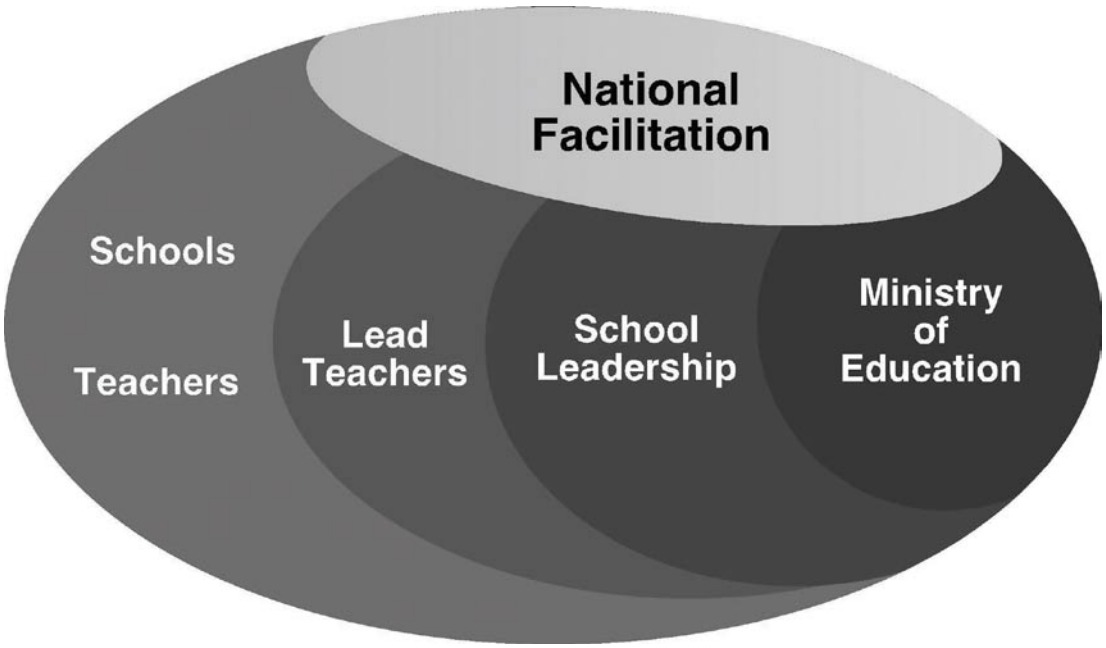

Figure 3. National Facilitation Conceptual Model

6. Impact

In 2009 a research project, *ICT PD Cluster Programme Research Review Project,* was funded by the New Zealand Ministry of Education (Clayton, et al 2009a). Two of the project's key themes were to assess, explore, identify, describe and report on:

- In what ways, and to what extent, did the provision of ICT PD increase the capabilities of teachers to use ICT effectively in their practice?
- What key features of the current model of ICT PD provision could be considered 'best international practice'?

Initially a desk-top literature review of past and current ICT PD programmes was undertaken. This involved evaluating national and international government research publications, strategic documents, academic journals and professional development web-portals focused on ICT PD. This desk-top work was supplemented by a review of ICT PD cluster reports, milestones and specific project research reports identified by the Ministry literature. In reviewing the material for the project, an 'intuitive-rational' approach was adopted. In essence, the intuitive-rational approach applied in this project involved the researchers identifying the salient themes within the material reviewed (Aldridge, Dorman, & Fraser, 2004). To reduce the bias of researcher-generated assumptions, the themes generated, conclusions drawn and recommendations offered, were submitted for peer review by other experts in the field.

The evaluations and commentaries providing a context for and/or serving to highlight the impact of the ICT PD cluster model can be classified within three broad categories;

- Commissioned Evaluations and Research: These include national trend papers (Ham, et al 2002: Ham, et al 2005), and formal project evaluations (Clayton, et al 2009).
- Associated Evaluations such as those initiated by the New Zealand Education Review Office (ERO 2005: ERO 2005a)
- Independent research: Including dissertations and theses (Rudolph 2005: Halliday 2000: Devery 2005: Ballantyne 2004).

In general, these studies indicated the basic concept of clustering for the provision of professional development through devolved funding resulted in a degree of success. Cluster participants acknowledged that the ICT PD programme enabled participating schools to achieve their goals of increasing the level of teachers' knowledge, competencies and confidence in using identified ICTs in their professional practice and school administrative tasks.

It also appeared that the National Facilitation team was able to provide appropriate 'just-in-time' advice and guidance when required. This support was directed, in many cases, at those relatively inexperienced in terms of the use of ICTs in teaching and learning, as well as cluster leaders (i.e. principals, facilitators, ICT coordinators and lead teachers). This support was intended to enable them to successfully acquire the requisite skills and experience to lead professional development initiatives for staff. It also aimed at helping the cluster leaders successfully manage and administer the full range of cluster activities.

7. Enablers, inhibitors and critical success factors

Detailed analysis of literature, national project reports prepared for the Ministry and individual school reports prepared for ICT PD clusters enabled the project team to identify those key attributes that either enabled or impeded the ICT PD Cluster model and the critical organisational and operational success factors which should be duplicated in any future model of ICT PD implementation (Clayton, et al 2009).

7.1 Enablers

7.1.1 *Levels of Awareness:* Successful clusters were those clusters that shared a common philosophy on the benefits of integration of ICT within their schools and were fully conscious of the demands placed upon administrators by contractual requirements of the cluster contracts; in short, they were fully prepared.

7.1.2 *Communication and Dissemination:* Clusters that met often and communicated regularly were able to create a sense of 'community'. Celebration of success at local, regional and national events raised the profile/standing of the facilitator and lead teachers within the cluster, within the wider school community and nationally. This recognition helped consolidate senior management support for the initiative.

7.1.3 *Leadership:* All participants recognised the critical role that principals and senior managers played in the success of the cluster. If cluster principals and senior managers communicated regularly with each other and fully supported the lead teachers and facilitators, the cluster was successful. If principals and senior managers took a neutral or even 'hands off' approach the cluster tensions increased and in general the cluster was not as successful as it could have been.

7.1.4 *Pedagogical Leadership and Focus:* It was consistently acknowledged that the acquisition of technical skills in ICTs on their own was not in and of itself an enabler of good teaching practice. The acquisition of technical skills and the resulting increased competence and confidence of teachers needed to be situated with applied examples of successful practice.

7.1.5 *Project Management:* Successful clusters were those that identified the potential 'risks' inherent in actions they contemplated and managed them. For example, the recognition that the increased provision of professional development on the use of interactive white-boards would drive a demand for increased investment in white-board technologies. By recognising the risk, an increased demand for investment, clusters were then able to seek extra/external funding or sponsorship or manage resource allocation differently.

7.2 Inhibitors

7.2.1 *Lack of specialist knowledge:* In some rural and distributed communities the specialist knowledge required to complete the contract was not available and the cost of external provision was extremely high. The issue of the impact of externally contracted facilitators not fully conversant with the schools needs, often with a roll-out focus on skills development, was consistently raised.

7.2.2 *Mismatch of technical infrastructure with demand-side requirements:* As professional development activities were delivered, teachers became more competent and capable in a range of applications and digital devices. As teachers then began to deploy them within their classrooms, they placed increasing demands upon the existing technical infrastructure and equipment available. Often the existing technical infrastructure was not capable of meeting the increased demand and there was a lack of available equipment.

7.2.3 *Lack of senior management engagement:* If individual school principals did not fully support the ICT initiatives offered within the cluster, facilitators found it very difficult to fulfil their duties effectively. Leaders (i.e. facilitators and/or lead teachers) were burdened with obstacles that were difficult to overcome and unmotivated, reluctant staff.

7.2.4 *Loss of key personnel:* When cluster principals, facilitators or lead teachers, for whatever reason, were unavailable to continue with the ICT PD Cluster programme, disruption occurred. National Facilitators noted it was difficult to replace key cluster personnel and cluster progress was hampered until new personnel were appointed and inducted into the cluster community.

7.3 Critical success factors: organisational

7.3.1 *Consistency of cluster composition:* The sector composition of clusters appears to impact upon their successful operations. The positive effects were proportionally greater within primary sector clusters than in mixed (primary-secondary) or secondary clusters. There was also a perception that secondary school teachers had fundamentally different needs and worked within different organisational structures to those of primary teachers. It would appear horizontal clusters (i.e. schools of the same sector) have a greater impact.

7.3.2 *Co-location:* There appeared to be consensus that schools close to each other shared a 'natural commonality' of interest. In essence, these clusters were serving the same or similar physical or cultural communities. It was also noted that localised clustering meant the provision of professional development, (i.e. the location of workshops, costs associated with travel) was more manageable. It would appear localised clusters (i.e. schools in the same geographical region) are more cost-efficient and manageable.

7.3.3 *Critical mass of participating teachers:* While small clusters appeared to be more able to create a sense of 'cluster community' there appeared to be no optimum number of schools to enable a cluster to be successful. Clusters with the greatest 'value added' have included anywhere between 5 and 25 schools. However, while the actual number of schools involved does not appear important, what does appear to be critical is the number of teachers engaged in cluster activity. Small (approximately 30 participants) to medium (less than 130 participants) enable a sense of community to be developed and appear to be more manageable. It would appear clusters engaging no more than 130 teachers in ICT PD activities are more able to meet the needs of participants.

7.3.4 *Quality of cluster facilitation:* A significant number of principals and teachers involved in the ICT PD programme recognised the quality of their cluster facilitator as being a key factor in determining its success. A facilitator appeared to need existing professional credibility, a sound knowledge of teacher education strategies and demonstrate a high degree of personal commitment to the ICT PD programme. In these cases they were able to generate a strong sense of community and significantly influence the impact of the ICT PD programme.

7.3.5 *Management support:* Facilitators, lead teachers and teachers all agreed that the extent of active commitment shown by principals and/or senior management personnel to the activities of the cluster was an influential factor in the impact of cluster activities on school ICT initiatives. Principals and/or senior managers needed to able to clearly articulate the benefits of participation in the ICT PD initiative to the stakeholders of the school.

7.3.6 *Team owned:* Both the national facilitation team and teachers within schools agreed that clusters and schools that paid attention to the creation of a sense of ownership and community were high 'value added' clusters. The basic concept underpinning the ICT PD initiative is 'empowerment'. Professional development should be designed specifically to meet the needs of clusters and to be delivered within them. The creation of a culture of 'team ownership' of the ICT PD was critical to its ongoing success.

7.3.7 *Appropriate ICT infrastructure:* An often aired and consistent concern expressed by a significant number of cluster participants was the reliability and robustness of the technological infrastructure. These concerns were focused on two areas. Firstly, inadequate student access to required equipment. Secondly, regular ICT equipment failure and the associated lack of technical support. It is apparent that participant schools should be able to demonstrate they have, or are planning to acquire, the appropriate ICT infrastructure to support their involvement in the ICT PD programme.

7.4 Critical success factors: operational

7.4.1 *Structure and Content that addresses skills, practice, and knowledge:* It is recognised that teachers' professional development activities cannot be easily compartmentalised; they are interwoven and overlapping. However, there appears to be a natural association between teachers acquiring skills (are competent), and deploying these skills in their professional practice (are confident) with an underlying belief that this use of ICT is beneficial to themselves as professionals and to their students as learners (are knowledgeable). This finding suggests that, in structuring a balanced ICT PD programme, three key elements should be addressed:

- Competencies (How): Practical sessions should be offered on 'how' to competently operate various ICTs both for administrative purposes and for learners to utilise them in their learning activities.
- Deployment (When): Sessions, enhanced by authentic New Zealand examples, should be designed to show 'when' ICTs can be successfully integrated into learning activities.
- Theory (Why): Sessions, enhanced by applied research, should be structured to illustrate 'why' using ICT in classrooms and for administrative purposes is beneficial to teachers, students and schools.

Ideally programmes should be designed with an overarching focus with potentially, a longer-term effect than those offered with a single topic or narrow focus.

7.4.2 *Optimal duration of 3 years:* It is generally agreed that the time a teacher is actively involved in ICT PD activities directly correlates with the frequency of their classroom and administrative use of ICTs. It is also generally agreed that increasing teachers' familiarity and competencies in computer operations and software applications can be relatively speedily addressed. However, improving teachers' levels of confidence of using ICTs within the classroom, developing strategies and techniques to empower students to seamlessly use ICT in their learning and increasing participants' knowledge of teaching and learning theory in regard to ICT use, take significantly more time. Ideally, teachers should be actively engaged for the full three years of the ICT PD programme.

7.4.3 *Co-learning delivery mode:* The professional development provided across clusters and within schools varied from group to group. There was a mix of formal and informal, technology-facilitated and face-to-face, internally delivered and external provision and short-term and long-term contracts. All methods, in one way or another, found favour with participants. It is therefore difficult to prescribe a set recipe for delivery. However, it is noteworthy that the preferred professional development learning options, (working one-to-one with a mentor/coach/tutor, collaborating with a regular partner and working in similar sector or skill level small groups) have remained relatively consistent over the duration of the ICT PD initiative. It would appear sensible that these aspects continue to be included in future ICT PD programmes.

7.4.4 *PD recognised as part of workload:* In general, teachers preferred professional development to be integrated into their recognised teaching workload. This meant they would be "released' to undertake the scheduled learning events. If this was not always possible, a significant majority indicated they would be willing to participate in organised after-school sessions. All other suggestions on timing of events generated consistently high proportions of negative feedback. Scheduling sessions for a half-day during term breaks or for 1-2 Saturdays per year were possibly acceptable. However, all other options presented (i.e. full days during term break or 3-4 Saturdays per year) created resentment. In designing professional development events these factors could be taken into account and activities scheduled accordingly.

8. Summary

To participate successfully in increasingly globally-connected learning environments, New Zealand schools and successive Governments have increased their funding for the provision of professional development in ICTs. This increased provision clearly acknowledges the competence and confidence of teachers in the educational use of ICT impacts directly upon the capacity and capability of schools to positively engage their learners in ICT-supported learning environments. The introduction and continuation of the ICT PD Cluster initiative has shifted schools and Government investment in PD from external provision to one with an internal focus. It replaced what could be described as a 'deficit' professional development model with an 'empowerment' model. It clearly indicates the Government's preference to empower schools to take ownership of the professional development process by becoming the analysers, producers, deliverers and consumers of relevant, authentic and sustainable professional development. However, the ICT PD model places extra demands upon school leadership. An identified risk inherent in the model is the ability of the existing leaders in schools to undertake the task of identifying and providing the appropriate PD activities to meet their specific needs. In mitigating this risk, the Ministry of Education funded a national facilitation team to assist school leaders to become familiar with the new tasks they faced.

This paper has shown that there is general agreement that the effects of long-term, school-based, whole staff PD are positive. It is also apparent that the support provided by a National Facilitation coordinating body was well received. This body was able to provide appropriate 'just-in-time' advice and guidance when required. In essence the basic concept of clustering for the provision of professional development through devolved funding has resulted in a high degree of success.

9. Acknowledgements

The author would like to thank the Ministry of Education e-Learning Team, Wellington for funding the initial research and Sarah-Jane Saravani and Richard Elliott members of the *ICT PD Cluster Programme Research Review Project* research team.

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Strategies for mlearning integration: evaluating a case study of staging and scaffolding mlearning integration across a three-year bachelor's degree

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This paper outlines the third iteration of integrating mobile Web 2.0 within a bachelor's level course in Product Design. An analysis and comparison of the impact of mobile Web 2.0 across all three years of the 2009 course enables the development of implementation strategies that can be used to integrate mlearning into other tertiary courses, and inform the design of further Product Design mlearning integration iterations.

Keywords: *mlearning, Web 2.0, case study, implementation strategies*

1. Introduction

The integration of mlearning across the 2009 Bachelor of Product Design programme was the result of the third iteration and refinement of a participatory action research project investigating the potential of mobile Web 2.0 in tertiary education. What began as an investigation of the affordances of Web 2.0 in 2007 developed into a mobile Web 2.0 proof of concept project within the third year of the Bachelor of Product Design in 2008, and then quickly spread to projects within the first and second year of the programme in semester2 of 2008. The success of these projects led to the integration of mobile Web 2.0 technologies (based on an explicit social constructivist pedagogy) across all three years of the programme in 2009 (http://www.youtube.com/watch?v=8Eh5ktXMji8). The aforementioned projects formed one case study of a wider mlearning research project spanning 2007 to 2009 involving multiple course contexts. The research questions were:

- What are the key factors when integrating Wireless Mobile Devices (WMDs) within tertiary education courses?
- What challenges/advantages to established pedagogies do these disruptive technologies present?
- To what extent can WMDs be utilized to support learner interactivity, collaboration, communication, reflection and interest, and thus provide pedagogically rich learning environments that engage and motivate the learner?
- To what extent can WMDs be used to harness the potential of current and emerging social constructivist e-learning tools?

Pre-trial surveys captured the participants' previous mobile Web 2.0 experiences. Throughout the duration of the project lecturers and students then attended a weekly community of practice (COP) to investigate and support the integration of mobile Web 2.0 tools into their courses. Participant feedback was captured via their online Web 2.0 sites, including a blog/eportfolio. A post-trial survey and focus group discussion were also used to capture participant feedback.

During 2008, participating lecturers noted that the integration of mobile Web 2.0 within the course significantly engaged students and provided the basis for a flexible, context independent learning environment. On that basis the Product Design lecturers, along with the help of the researcher (the technology steward (Wenger, White, & Smith, 2009; Wenger, White, Smith, & Spa, 2005)), planned the integration of mobile Web 2.0 tools across all three years of the course for all Product Design students and lecturers in 2009. While it was believed that a student-owned smartphone model was the best ultimate approach, it was decided to further the seeding of mobile Web 2.0 into the programme by providing students with institutionally loaned smartphones. The cost of both the smartphones and mobile data

dropped significantly during 2008 and 2009, and a variety of student-owned funding models will be explored for 2010 and onwards.

Focus group feedback from participating students in 2008 indicated that the coverage of mobile Web 2.0 affordances during the 2008 COPs was too broad, presenting a high cognitive load for the students. Students were overwhelmed by the options available in the timeframe provided, and would have preferred to have focused on fewer affordances, and to have used them well. Therefore specific mobile affordances were chosen and utilised as a focus in the 2009 Product Design course (See Table 1, the tinyurls reference Educause '7 things' series of articles on each technology). Students' core activity was situated around a reflective blog (http://www.vox.com) that was accessible via mobile devices, and provided a key source of participant reflections. Students' Vox Blogs were planned to become reflective journals of their design processes and learning throughout the year, as well as building up a showcase (eportfolio) of their Product Design capabilities. In particular the use of Vox Blogs was expected to increase students abilities to:

- Become critical reflective thinkers as well as creative designers
- Collaborate, communicate and convey ideas
- To work with new technologies as part of the process (mobile Web 2.0 being core in enabling this).

Activity	Overview	Examples	Pedagogy
Video streaming	Record and share live events	Flixwagon, Qik http://www.qik.com	Real-time Event, data and resource capturing and collaboration.
Geo tagging	Geotag original photos, geolocate events on Google Maps	Flickr, Twitter, Google Maps http://tinyurl.com/5a85yh	Enable rich data sharing.
Micro-blogging	Post short updates and collaborate using micro-blogging services	Twitter http://tinyurl.com/2j5sz3	Asynchronous communication, collaboration and support.
Txt notifications	Course notices and support	Txttools plug-in for Moodle and Blackboard	Scaffolding, learning and administrative support
Direct screen sharing	Video out to video projector, or large screen TV	Microvision Show http://tinyurl.com/celgot	Student presentations, peer and lecturer critique
Social networking	Collaborate in groups using social networking tools	Vox groups, Ning, peer and lecturer comments on Blog and media posts http://tinyurl.com/4uz6rj	Formative peer and lecturer feedback.

Table 1. Affordances of smartphones mapped to social constructivist activities

In order to achieve an explicit move to a social constructivist learning environment using mobile Web 2.0 tools in 2009, a staged and scaffolded approach was adopted. The 2009 project implementation was influenced by reflections upon the 2007 and 2008 mlearning projects, and also the recent conceptualizations of mlearning around the emergence of new learning theories based broadly upon social constructivist foundations. These included: Authentic learning (J. Herrington, Mantei, Herrington, Olney, & Ferry, 2008), Pedagogy 2.0 (Catherine McLoughlin & Mark Lee, 2008), Learner Generated Contexts and the Pedagogy, Andragogy, Heutagogy (PAH) continuum (Luckin, et al., 2008). The planned staged approach therefore allowed the bridging of the PAH continuum (Table 2), and the embedding of mobile Web 2.0 affordances that support each stage.

	Pedagogy	Andragogy	Heutagogy
Locus of Control	Teacher	Learner	Learner
Educational sector	Schools	Adult education	Doctoral research
Cognition Level	Cognitive	Metacognitive	Epistemic
Knowledge Production Context	Subject understanding	Process negotiation	Context shaping

Table 2. The PAH continuum, from Luckin et al (2008, p. 10)

The integration of mlearning (mobile Web 2.0) across the three years of the Bachelor of Product Design programme in 2009 was structured as follows in Table 3, creating a progression from pedagogy (lecturer-directed) in first year facilitated by the introduction of Web 2.0, to heutagogy (student-directed) in the third year facilitated by the unique affordances of mobile Web 2.0 to create student-generated contexts.

Implementation Stage	Web 2.0 tools	MLearning tools	Course timeframe and focus	PAH alignment
Level 1	Social collaboration with peers and lecturer	Introduction of netbooks and establishment of basic Web 2.0 sites	Semester 1, year 1 blogging	Pedagogy
Level 2	Student generated content	Netbook plus mid-range smartphone (Nokia XM5800)	Semester 2, year 1 student vodcasts, geotagging, moblogging	From pedagogy to andragogy
Level 3	Social collaboration with peers and external 'clients'. Context Aware	Student-owned laptop plus mid-range smartphone (Nokia XM5800)	Year 2 social networking, mobile codes, geolocation	Andragogy
Level 4	Context independent. Student generated contexts.	Student-owned laptop plus high-end smartphone (Nokia N97)	Year 3 microblogging, facilitation of 'virtual studio', location recording	From andragogy to heutagogy

Table 3. Scaffolding the rollout of mobile Web 2.0 throughout the Product Design course

2. Bachelor of Product Design 2009 mLearning projects

The entire three years of the Bachelor of Product Design course were included in the 2009 mlearning project, allowing staging of the cognitive and technological learning required to integrate these tools.

2.1 First year mobile project

The first year project was designed to lay a foundation for the mobile Web 2.0 projects to be built upon in the second and third year of the course. The pedagogical focus was thus more teacher-directed (pedagogy). The first year project integrated blogging, followed by moblogging (mobile blogging) into the course. Scaffolding the introduction of Web 2.0 and mobile Web 2.0 tools into the students learning experience facilitated the beginnings of their online eportfolio and was an introduction to the educational use of social networking for collaboration. The core assessment involved an online Blog/eportfolio documenting and showcasing students' design processes and forming the basis of the beginnings of a collaborative hub with

their class peers. Students were supplied with a Dell mini9 3G netbook in semester one, and this was supplemented with the addition of a Nokia Xpressmusic 5800 smartphone at the end of semester one. The course projects are outlined on Google Docs:

- PIC2 Project 1 http://docs.google.com/View?id=dchr4rgg_55r5gntvf7
- PIC2 Project 2 http://docs.google.com/View?id=dchr4rgg_57c3xj5qg7

2.2 Second year mobile project

The focus of the second year project was on a move from pedagogy to andragogy, building on the students' first year mobile Web 2.0 experience, integrating moblogging, social networking, and student-generated content into the course, facilitating more in-depth collaboration and peer critique. The majority of these students had established an online eportfolio in the previous 2008 mlearning project. The 2009 project utilised the Nokia Xpressmusic 5800 to facilitate an assessed online Blog/eportfolio documenting and showcase students' design processes, forming the basis of collaborative critique and show-casing with worldwide peers and potential employers or clients. Ning was used as a teacher-facilitated collaborative hub for all the projects. Second semester projects focused on sharing and critiquing projects using Google Docs and Vox Group blogs, using the smartphone to capture and share project progress and presentations. Course outlines are available on Google Docs:

- Gown Design Project http://docs.google.com/View?id=dchr4rgg_47cwtgcwcf
- ManTech Project http://docs.google.com/View?id=dv83r4v_33f89b4fhm

2.3 Third year mobile project

The third year mlearning project focused upon the unique affordances of mobile Web 2.0 to create context-bridging learning environments that facilitated a move from Andragogy to student-generated projects and student-generated contexts (Heutagogy). Students and lecturers were supplied with Nokia N95 smartphones and these were upgraded to the Nokia N97 in Semester two. The third year course is based around a Studio Design model where students undertake three design projects throughout the year, one of which is substantial and developed by the students themselves, with the guidance of their lecturers. The project involved documenting the research and design of these products throughout the year, including working with a client company in small design teams. The first project was a collaborative project with Applied Trades and Landscape Design students. The mobile Web 2.0 technologies were also used to establish a weekly 'nomadic' studio session with staff and students focusing on context bridging and full integration of moblogging into course projects. Students were required to maintain an online Blog/eportfolio documenting and showcasing their design processes and forming the basis of a collaborative hub with worldwide peers and potential employers/clients. Additionally, communication and collaboration made use of instant messaging, microblogging, and reflective VODCasts during the 'nomadic' (beyond the classroom) studio session. Two of the third year project briefs are available on Google Docs:

- Shac09 Project Brief http://docs.google.com/View?id=dchr4rgg_44f4v8kccx
- NPC Project Semester2 http://docs.google.com/View?id=dv83r4v_8ddxfbkfg

3. Discussion

A comparative analysis of student activity and feedback across the three year-groups of the course provides a basis for critiquing the success of the staged implementation of mlearning integration into the course in 2009. A comparison of the three mobile usage surveys indicates significant average smartphone use differences between the three years of the course. The first year project's main focus was upon developing students use and integration of Web 2.0 tools (facilitated by the netbook and the smartphone), rather than upon the unique affordances of the smartphone, this being the focus of the second and third year projects. Thus while the first year students experimented with the unique multimedia affordances of the smartphones they did not (in general) as a group socialize the everyday use of these unique affordances into their course. The use of the unique affordances of the smartphones was encouraged, but was

optional in their projects. The structured nature of the first year projects followed a more teacher-directed pedagogical learning environment than the second and third years.

The second year students, in general, socially rejected the unique affordances of the XM5800 smartphone and tended to revert to standard use of the phone, with the exception of image and video blogging that were used for facilitating student-generated content. This was because many of the second year students found the XM5800 too complicated for these general activities. While the unique affordances of the smartphone were introduced by the technology steward (researcher) they were not modeled by the second year lecturer within authentic contexts, and therefore students struggled to conceptualise the use of these affordances within their course. Most of the second year students expressed their engagement with the mlearning project, but rejected the XM5800 as a device. Their feedback indicated that they preferred the previous 2008 mlearning project use of the iPhone 3G when they were first year students. *'The Nokia's UI was so bad and non-intuitive that I didn't use the phone as much as I wanted to - I really like the whole idea - just not this phone'* (example second year student feedback). Interestingly many of the students in the other second semester mlearning projects (Architecture and Performing and Screen Arts) expressed deep personal appropriation of the XM5800, with most reluctantly returning the device at the end of their 2009 projects. The social non-appropriation of the XM5800 by one or two vocal students appears to have been very influential in the second year Product Design project. This illustrates the influence of the social construction of technology (Bijker, 1995) on technology appropriation.

In contrast the third year students appropriated the multimedia and communications capabilities of the N95 and N97, using a wide range of mobile Web 2.0 affordances including instant messaging, Twitter, and QR Codes. The GPS and maps integration of the smartphones was also highly rated by the students, but used most frequently by third year students. The third year students maximized the use of the unique affordances of the smartphones within authentic contexts provided by their unstructured final year design projects which followed the development of a heutagogical learning environment modeled by the course lecturer (Cook, Bradley, Lance, Smith, & Haynes, 2007; Cook, Pachler, & Bradley, 2008; Luckin, et al., 2008).

The mlearning integration within the course was scaffolded by the use of an intentional community of practice (COP) model (Langelier, 2005) comprising weekly support sessions involving the course lecturers, the researcher (as the technology steward) and the course students. The face-to-face weekly mlearning COP support sessions were highly valued by the first and third year students and lecturers, forming the basis of a significant learning community around the mlearning projects. However, unlike the first and third year projects, the second year lecturer did not place as much value on the weekly COP sessions, often postponing them, double-booking with guest lecturer sessions, or simply forgetting about them and did not regularly attend the COPs himself, leading to weak learning community formation around the mlearning project in the second year.

3.1 Student feedback

The final student surveys and focus group questions provided further data on student feedback on the three 2009 Product Design mlearning projects. Table 4 below summarises and compares student feedback in the form of answers to the final student survey questions.

The feedback from the third year students was overwhelmingly positive, indicating that the mlearning integration into their course was perceived as very beneficial in almost all areas. The majority of first year students enjoyed the mobile Web 2.0 projects, with none finding them a disagreeable experience. Though largely negative about the smartphone used in the project, more than 90% of the second year students found the experience fun. Most first and second year students appropriated the personal use of the smartphones but did not use their unique affordances to enhance group collaboration and communication, particularly with their lecturers who had not supplied their phone numbers or utilized instant messaging or Twitter to facilitate communication with their students. Very little formative feedback was posted as comments to students' blogs by the second year lecturers. In contrast the first and third year lecturers actively participated on the student blogs. Additionally, several of the third year students utilized instant

messaging and Twitter on their smartphones to stay in constant communication and collaboration with their lecturer, the researcher, and their student peers, facilitating a context independent learning community that the second year students did not experience.

End of project survey question	Percentage student agreement/ satisfaction with statement (strongly agree plus agree)		
	Year 1	Year 2	Year 3
4. What has been your experience of group work facilitated by Blogs and RSS?	60%	57%	80%
6. It was easy to use the smartphone?	20%	64%	100%
7. This mobile learning experience was fun.	70%	55%	100%
8. Based on my experience during this trial, I would use a smartphone in other courses	50%	65%	100%
9. I would be willing to purchase my own smartphone?	40%	73%	100%
11. In your opinion, does mobile learning increase the quality of learning?	80%	73%	100%
12. Mobile blogging helped create a sense of community (group work)?	60%	82%	80%
13. Accessing your course blog was easy using the mobile device?	40%	46%	100%
14. Mobile learning increases access to education?	50%	64%	100%
15. Communication and feedback from the course tutor/ lecturer were made easier?	70%	55%	80%
16. Mobile learning is convenient for communication with other students?	90%	82%	80%

Table 4. Comparative Product Design Student Survey Feedback 2009

3.2 Blog analysis

Student blogs were a source of personal and collaborative reflection and critique. While the third year project began in March 2009, the second and first year mobile Web 2.0 projects both began in May 2009. As Figure 1 indicates, the mid-year break in June/July saw a drop-off in student activity, particularly with the third year students who followed a much more self-directed learning timetable.

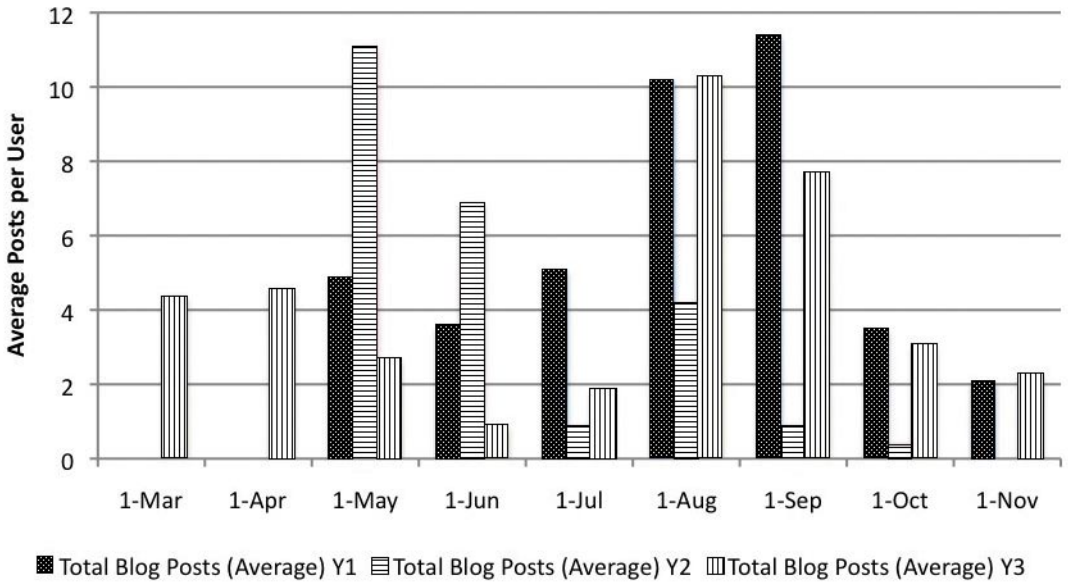


Figure 1. Comparative average blog posts per Product Design student group 2009

While initially exhibiting significant engagement by the second year students with blogging during the collaborative group 'Gown Design' project in semester one, they quickly lost interest during the second semester. The mlearning and blogging integration into the course lost focus as the second year lecturer failed to capitalize on the integration of mobile Web 2.0 into the course in the second semester.

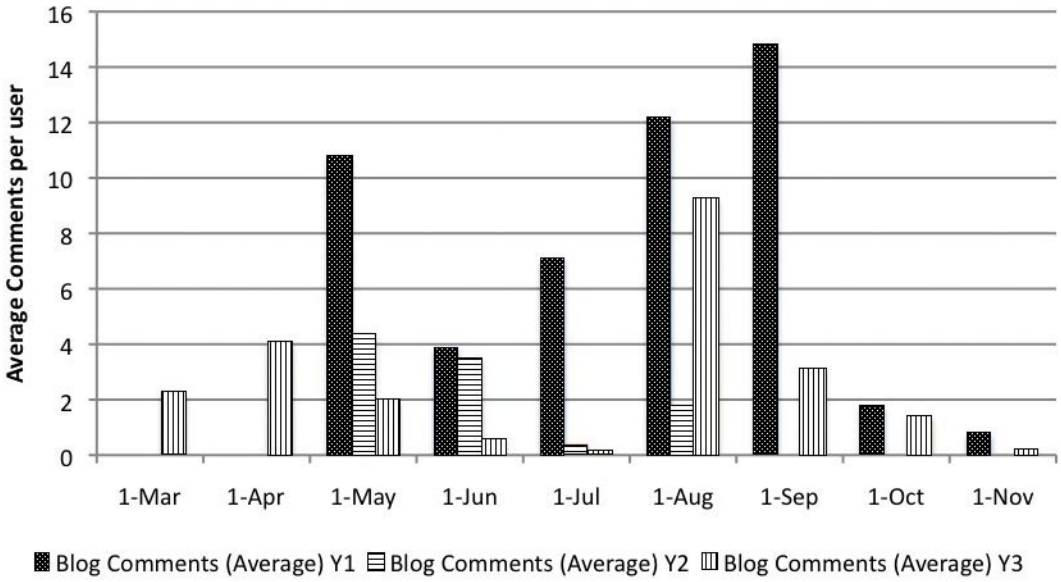
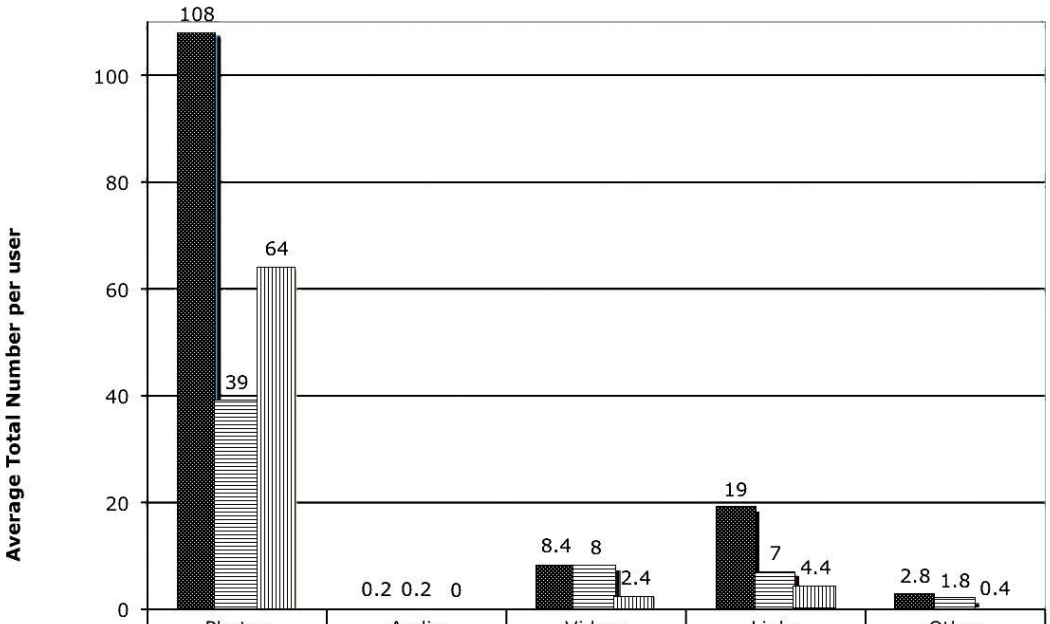


Figure 2. Comparative average blog comments per Product Design student group 2009

The number and regularity of comments on the students' blogs (Figure 2 above) indicates how much of an interactive and collaborative learning community was established. First year students and their lecturers were highly active in commenting on each others' blog posts. The Second year course was notable in the lack of formative feedback given to students as comments from lecturers on their blog posts. This lack of engagement by the second year lecturers with the student blogs reflected in the students' perceptions on the lack of course integration and importance of their blogs, resulting in a quick drop-off in engagement in the second semester, which in the researcher's view was a wasted opportunity on the part of the lecturer.



	Photos	Audio	Videos	Links	Other
Year1_2009	108	0.2	8.4	19	2.8
Year2_2009	39	0.2	8	7	1.8
Year3_2009	64	0	2.4	4.4	0.4

Figure 3. Comparative blog media elements per Product Design student group 2009

The majority of media uploaded to student blogs was captured via the smartphones. As Figure 3 indicates, the bulk of this media was in the form of still images, followed by web links to resources and closely followed by videos ñ either original recorded videos from their smartphones or embedded YouTube videos. Links to Google Docs and Picasa Slideshows (collections of images formatted as interactive online albums) were also popular. First year students uploaded a surprising number of images to their blogs. The student-content creation focus of the first year project generated a lot of engagement from the students.

4. Case study analysis

This section brings out some of the key themes highlighted by the mlearning integration into the Bachelor of Product Design programme in 2009.

Lecturer and student feedback on the project are available on YouTube:

Lecturer feedback: http://www.youtube.com/watch?v=mmTI7F_2tiU

Student feedback: http://www.youtube.com/watch?v=X1Sb-tvXrvA

4.1 Implications for the research questions

In general the integration of mobile Web 2.0 technologies into the Bachelor of Product Design has been very successful. As the case studies show, the student and lecturer experience within the programme have been enhanced through the facilitation of a social constructivist environment that bridges multiple contexts. Over the last three years significant changes in pedagogical approach and levels of student engagement have been realised. The future aim is to continue to build upon the insights gained focusing upon the PAH alignment of the unique affordances of mobile Web 2.0 (Table 1) using a staged and scaffolded model (Table 3) to fully embed mobile Web 2.0 tools into the entire Bachelor of Product Design curriculum. Additionally, the importance of both technical and pedagogical scaffolding for both the lecturers and students via a community of practice model has been found to be critical.

While the research has sought to produce transferable principles and strategies to enhance tertiary education using mobile Web 2.0, it is ultimately bound by the limits of the contexts of the learning communities that it is embedded in, and the current affordances of the available mobile Web 2.0 technologies. To create a sustainable approach, the goal going forward is to move to a student-owned model, where students purchase their own smartphone. It is yet to be seen whether there can be transferability of the research outcomes based upon an institution supplied or specified WMD and mlearning projects based upon student chosen and owned WMDs (Traxler, 2010).

4.1.1 What are the key factors in integrating Wireless Mobile Devices (WMDs) within tertiary education courses?

While every implementation of mlearning and each learning context will be unique, several key factors have been identified by the research that have proven to be important across multiple mlearning implementations and contexts (Cochrane, 2010). The pedagogical integration of the technology into the course criteria and assessment is critical. Lecturer engagement and modeling of the pedagogical use of the WMDs is essential. These changes in curriculum design and practice (and student acceptance) take time (Chi & Hausmann, 2003): in the example case study given this time frame has spanned several years. Innovative practice must take a scaffolded and staged approach to implementation, and lecturers (and students) require significant pedagogical and technical support during this time.

4.1.2 What challenges/ advantages to established pedagogies do these disruptive technologies present?

Mobile Web 2.0 tools are 'disruptive' technologies (Sharples, 2001) that democratize the learning environment, empowering students, and providing opportunities for social constructivist pedagogies. The ubiquitous connectivity of WMDs combined with the student content creation and sharing capabilities of Web 2.0 shift the learning focus from teacher-directed to student-centred learning (Bruns, 2007; Cochrane, Bateman, & Flitta, 2009; Laurillard, 2007). This learning can then occur across almost any context, bridged by the ability of the WMDs to augment, capture, share and communicate learning experiences (Cochrane, 2009; Vavoula, 2007). This changes the role of the educator and the nature of learning for the students. For

many lecturers integrating a social constructivist learning environment will mean redesigning assessments and developing a new pedagogical 'toolkit'. This takes time and commitment. Technological and pedagogical support for these paradigm shifts is critical. These disruptions facilitate appropriate shifts along the pedagogy to heutagogy continuum (Cochrane, Flitta, & Bateman, 2009; Luckin, et al., 2008; C McLoughlin & Mark Lee, 2008)

4.1.3 To what extent can these WMDs be utilized to support learner interactivity, collaboration, communication, reflection and interest, and thus provide pedagogically rich learning environments that engage and motivate the learner?

Mobile Web 2.0 can be used to facilitate collaborative, authentic learning within authentic contexts (A. Herrington & Herrington, 2007; A. Herrington, Herrington, & Mantei, 2009). The aggregation of a variety of mobile Web 2.0 tools facilitates metacognition and reflection. Students demonstrate increased motivation and engagement when using personal devices and personalized media-rich learning spaces (JISC, 2009a, 2009b). Students initially engaged by the use of personal and innovative technologies can appropriate the pedagogical use of these tools when scaffolded and supported by learning communities guided by an appropriate technology steward (Cochrane, 2007; Wenger, et al., 2009; Wenger, et al., 2005).

4.1.4 To what extent can WMDs be used to harness the potential of current and emerging social constructivist e-learning tools?

Since the researcher's first attempts at marrying the affordances of Web 2.0 and mobile technologies in 2006, mobile Web 2.0 has developed into a range of viable, user-friendly, rich-media, flexible and context independent tools (Cook, et al., 2007) that can be used to bridge both the formal and informal learning environments (Vavoula, 2007), spanning both distance and time. As these tools develop further, so will their educational potential and richness.

5. Conclusions

The Product Design mlearning projects achieved significant progress in course integration, pedagogical reconceptualization, and development of a staged and scaffolded implementation model for developing learning communities facilitated by intentional communities of practice across each year of the course. The case study illustrated the potential to stage and scaffold mlearning integration across all three years of a Bachelor level course, starting with establishing a learning community culture involving both the students and the lecturers and facilitation of a progression of teaching paradigms from pedagogy to heutagogy (PAH) (Luckin, et al., 2008) following the first year to third year of the course. The PAH continuum maps well with the progression of mobile Web 2.0 course integration from Web 2.0 appropriation (JISC, 2007, 2009a) in the first year to student mobile facilitated content creation (Bruns, 2007; JISC, 2009b) in the second year, and finally the context independence and bridging affordances of mlearning (Luckin, et al., 2008; Vavoula, 2007) leveraged in the third year 'nomadic studio'. Both positive and negative influences on the integration of mlearning within the course were identified and discussed.

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Interactive learning with Tablet PCs: tips for teachers

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Much potential is seen for using Tablet PCs interactively with classes to engage students and to help them learn. However, there are also many pitfalls that teachers need to consider. In this study, students at a New Zealand polytechnic, who were using Tablet PCs interactively in a mathematics class, were surveyed to investigate the perceived advantages and disadvantages for effective learning. This paper reports the learning benefits that students experienced and then focuses on the issues raised by students and the lessons learnt by teachers. It concludes with a set of recommendations that should help teachers intending to use Tablet PCs for interactive learning activities in classes.

Keywords: *tablet PCs design, skills effectiveness changing, tools*

1. Introduction

Literature on learning emphasises that students should take an active part in their learning and do more than just listen in class. One way to promote active learning can be to use technology which enables communication and collaboration in the classroom (Bransford, Brown and Cocking 2000). Tablet PCs are suited to improving communication and interactivity in class as they can allow students to share their work with other students and with the teacher. Using Tablet PCs interactively in this way has the potential to provide benefits for student engagement and student learning. This study investigates the benefits of using Tablet PCs and then focuses on the issues that teachers should consider.

2. Background

Research has shown that using Tablet PCs for interactive learning activities can help students learn, but that any new technology can have both advantages and disadvantages. Teachers must consider these and learn how to adapt their lessons for maximum benefit to student learning.

Using Tablet PCs in classes has been shown to improve student engagement. In one study (Mauch 2008), attendance improved and the percentage of students who submitted assignments improved. Students were also observed arriving early to class to use a Tablet PC to revise work from previous lessons. In another study, 100% of student respondents reported that using Tablet PCs in a lecture was a positive experience and 71% reported that submitting answers that could be chosen by the teacher for public display to the class increased their motivation (Greenwood and Haughian 2006).

Other important benefits for students using Tablet PCs are immediate feedback and learning from peers (Linnell et al. 2007). Roy and Luthra (2008) reported that students also appreciated the ease of taking notes during lessons.

Introducing new technology such as Tablet PCs can create challenges for both students and teachers. Technical problems are often reported (e.g. Neal and Davidson 2008) and good systems are needed for distributing and setting up Tablet PCs (Huettel et al. 2007). Students may need to learn how to use technology cooperatively, for example Greenwood and Haughian (2006) found after viewing video footage of lessons, that males tended to dominate control of the electronic pen. Furthermore, students may choose not to submit their answers (Anderson et al. 2007; Koile and Singer 2008).

Teachers also need to adapt to using Tablet PCs in a class. This involves learning to select pedagogy that is suitable for both the learning goal and using Tablet PCs. Linnell et al. (2007) described how teachers need to first consider learning goals for the course and then identify learning goals for an individual lesson. To help achieve each learning goal, activities with Tablet PCs can be planned and a suitable pedagogy selected for

each. The pedagogy selected should take advantage of the features of Tablet PCs and may be different from that of more traditional activities.

Two pedagogies that have been developed for Classroom Response Systems, in which students use clickers to submit answers to multi-choice questions, are "Peer Instruction" (Mazur 1997) and "Question-driven Instruction" (Beatty et al. 2006). Using Tablet PCs is very similar to using clickers but students can create a wider range of types of answers by writing on Tablet PCs with electronic pens.

Mazur's Peer Instruction is based around "ConcepTests" which are multi-choice questions which focus on understanding a concept. Students are asked to read lecture notes before coming to class and the lecture includes several ConcepTests which take about 15 minutes each. The format for ConcepTests involves a sequence of steps:

- Teacher introduces concept with a short presentation
- Students consider a ConcepTest question and individually submit their answers on their clicker
- Students discuss their answers with neighbouring students
- Students submit revised answers
- Teacher leads a discussion in which students explain answers
- Teacher displays tally of student answers and explains correct answer.

Peer Instruction was originally designed for large lectures but it has also been found to improve engagement in small classes (Crouch and Mazur 2001). Mazur found that, at times, peer instruction was more effective than the teacher's explanation and suggested this could be because students who had just mastered a concept could easily identify the difficulties of understanding the concept.

In Beatty et al.'s Question-driven Instruction, the teacher displays a question to the class, usually without introducing it. Students discuss the question in groups and submit their answers. The teacher displays the students' answers but does not comment on their correctness. The teacher then leads a class discussion in which students explain the reasons for their answers followed by the teacher explaining the correct answer.

As well as choosing appropriate pedagogy, the effectiveness of using Tablet PCs depends on a teacher's ability to respond effectively to the increased number of student contributions made in class (Neal and Davidson 2008). For example, Koile and Singer (2006) observed a teacher who, after viewing student submissions, spent more time attending to student misconceptions in some cases and provided more challenging questions in others.

Teachers also need to be competent and confident with the technology. Loch and Donovan (2006) reported on students who attended two classes in which the teachers had differing levels of confidence with using a Tablet PC to present their material. Students found it easier to understand the material presented by the teacher who was more confident with the technology.

Thus, there are many factors to be considered by a teacher when introducing Tablet PCs into lessons and these are investigated in this study. This paper focuses on the lessons that were learnt when Tablet PCs were introduced into a mathematics course at a polytechnic in New Zealand.

3. Method

The setting for this study was a discrete mathematics course at Christchurch Polytechnic Institute of Technology in New Zealand. We chose this course because the students, in the first year of a computing degree, found it difficult to be motivated for the compulsory mathematics course and we hoped that using Tablet PCs would help students engage with the course. Each lesson was restructured to include interactive learning activities in which pairs of students shared Tablet PCs. The free software used to distribute questions and collect submissions over a wireless network was Classroom Presenter (Anderson et al. 2006). The pedagogy chosen for the activities was based on Mazur's Peer Instruction (1997) but was modified to suit

the use of Tablet PCs instead of clickers. Data about changes in student engagement and impact on student learning were collected through student surveys, and teacher observations were also recorded. These were analysed to identify issues so that improvements to lessons could be proposed.

Mazur's Peer Instruction (1997) was chosen because its principle of introducing topics and then asking questions was similar to our existing teaching style. However, we modified Mazur's ConcepTest sequence because, to encourage peer instruction, the students worked in pairs on Tablet PCs as recommended by Linnell et al. (2007), and a greater range of types of answer was possible than with clickers. The peer instruction occurred while students worked together answering questions, rather than after submitting an individual answer on clickers. The class discussion focussed on the variety of answers that were submitted by students and displayed to the class. Each learning activity used the following Activity Sequence:

- Teacher introduced concept with a short presentation
- Teacher displayed question and distributed it to students
- Students worked in pairs to answer the question on the Tablet PC
- Students submitted their answers
- Teacher selected and displayed students' submissions
- Teacher led a discussion of students' submissions
- Students annotated their answer on their Tablet PC and saved it for later study.

The authors of this paper are the teachers for the course in alternate semesters. We have used Tablet PCs for four semesters with classes of between 12 and 25 students. In the first two semesters, the non-teaching author attended all class sessions and recorded observations about student and teacher behaviour and design of the learning activities. In addition, the teachers recorded their observations and reflections in all four semesters.

In order to collect data from as many students as possible, paper questionnaires were completed at class sessions that all students attended because of a course assessment. In the questionnaire, students described the impact that using Tablet PCs had on their learning as well as listing advantages and disadvantages. There were a total of 71 adult students who completed questionnaires and two other questionnaires were discarded because they were incorrectly filled in. The mathematical background of the students varied. 18 out of 40 students who were tested (45%) had low Mathematics Self Confidence as measured by the Betz MAS (Pajares and Urdan 1996) and Marsh SDQIII (Gourgey 1982) tests.

The questionnaire data were examined in order to find out what helped and hindered student learning and then analysed to determine what teachers could do to improve student learning.

4. Results and discussion

In the first part of this section, students' perceptions of the impact of using Tablet PCs are reported as well as teachers' observations and reflections. In the remaining parts, the issues which arose are identified and discussed.

4.1 Student engagement and learning

Most of the 71 students liked using Tablet PCs as 94% reported that they enjoyed using them and 100% reported that they were easy to use. Typical comments were:

> *"More interesting so staying focused on the lesson is easier"*
>
> *"Get to work with other people"*
>
> *"Can submit an answer without fear of getting it wrong because it's anonymous"*

Thus, reasons that students were more engaged were that they found it more interesting, and that they liked the interaction and participation. Students appreciated that submissions were anonymous and this probably encouraged participation.

Using Tablet PCs made a positive contribution to students' learning. Most students (90%) agreed that using Tablet PCs helped them learn, three students disagreed and four were not sure. Many student comments about the advantages of using Tablet PCs included explanations of how Tablet PC activities helped them learn. For example:

> *"Can see what you did wrong from others"*
>
> *"The answers can be corrected immediately & know the reasons why they are correct or incorrect"*
>
> *"Everyone gets to have their work marked by the tutor"*
>
> *"Helped learn better because study was done in partners so more brainstorming"*
>
> *"Working with a partner meant if one did not follow as well, the other could help out"*

Thus, students felt that the main benefits to learning were from the immediate feedback and from working with a partner.

As teachers, we observed that compared to previous years without Tablet PCs, students were more engaged with their learning and participated more actively in class. We observed that students started answering questions on Tablet PCs as soon as a question was distributed and that they worked hard to complete them. Students worked together and helped each other. They appeared to enjoy seeing both their own answers and those of others.

Like the students, and Linnell et al. (2007), we saw the immediate feedback as having the most impact on students' learning. We felt that when we gave feedback on an individual submission, other students also benefitted. Incorrect submissions usually generated the most discussion but it was also useful to be able to discuss alternative strategies that students had used successfully. We found that the improved engagement of students and their interest in discussing the submissions motivated us and energised our teaching.

Although the overall response from both students and teachers to using Tablet PCs was very positive, a number of issues were identified from student comments in questionnaires and from teachers' observations. These issues are described and discussed in the rest of this section.

4.2 Starting the lesson

As Tablet PCs were stored on a trolley, it took time for the teacher and students to set up at the beginning of each class. We found that the earlier the teacher arrived, the earlier some of the students arrived but that other students arrived late. It was difficult to start the class until all students were set up.

As the early students were waiting for something to do, we decided to remind students of previous work by offering a review question on the Tablet PCs. The review question led to two positive outcomes; it helped students learn and it created a structured start to the lessons. Many students (58 or 82%) reported that the review question helped them learn, with the most common reasons being that it reminded them of what they did last time or that it woke them up. On many occasions, we observed students looking up their notes from previous classes so that they could answer this question. Students began working on the review question as soon as they set up their Tablet PC and this set a good working atmosphere at the start of each lesson. Of the 13 students (18%) who did not find the review question helpful, 6 did not answer the question and 7 found it unhelpful. Most comments by these 7 students mentioned the limited amount of time spent on this question so they probably arrived late. We felt that all students had enough time to think about the question and start answering it but we could perhaps help by making sure students understand that even if they arrive late they can still learn from the discussion of the question and then save it for later study. One student described how much better it was to start by doing a review question on the Tablet PC than to begin with a passive activity such as a lecture or a presentation.

The contribution the review question made to learning and lesson structure was so successful that we now start every class with a review question. This has both allowed us to implement the well-established principle of reviewing the previous lesson and helped us create a structured start to lessons.

4.3 Catering for faster students

Students worked at different rates and a major advantage of using Tablet PCs was that questions were not answered verbally by the quick-thinking students. This gave other students time to answer questions at their own pace. However, at times, particularly in larger classes, the faster students needed an additional challenge while waiting for others to finish.

We tried displaying additional questions on an overhead projector (OHP). We chose questions from the textbook that had worked solutions so that students could complete them in their own time if necessary and check their solutions. We observed only a few students using these questions and this was to be expected as their purpose was to occupy and challenge the faster students. A few students, who appeared to have used the additional questions, made positive comments about how the additional questions helped them learn, but most of these students also said they only had time to do them on a few occasions. One student liked being able to get more work done in class and another liked trying a different style of question. Yet another student suggested that the additional questions could be offered on the Tablet PC.

A few other students, who appeared not to have used the additional questions, made negative comments. Two students didn't like the "old technology" of an overhead projector and two students thought they were too hard to read. The additional questions on the OHP were from the textbook but one student incorrectly thought there were no answers and another incorrectly thought the question had to be copied onto paper. Several students said they didn't have time to do them.

Although the additional questions were useful for the faster students, they appear to have been distracting for others. We need to find a better method of providing additional questions and we expect that future software will allow us easily to deliver these questions on the Tablet PCs. The questions should not distract the majority of students, who will not have time in class to do them, but these questions need to be easily accessible by the faster students.

4.4 Selecting answers for public display and discussion

Two students reported that incorrect submissions were not always discussed fully if most of the other submissions were correct.

Although this was mentioned by only two students we were surprised as we enjoyed displaying and discussing student submissions. We felt empowered to address actual student misconceptions and by incorporating students' answers and strategies into the lesson, we felt closer to the students' learning. Asking students to identify errors and strategies generated useful discussion. However, we were also aware that although submissions were anonymous, some students had low Maths Self Confidence and at times we observed students looking uncomfortable when an incorrect submission was publicly displayed. We had therefore been careful not to over-emphasise isolated incorrect submissions when the majority of the class showed good understanding.

It appears that we need to try to discuss as many incorrect submissions with the class as possible and we now show a positive interest in incorrect submissions by mentioning that you can learn the most from them.

4.5 Encouraging students to share

Two students reported problems with partners disagreeing on an answer and one student reported a partner who dominated the use of the electronic pen.

As teachers, we had not observed problems with sharing but these comments caused us to reflect that computing students need to be able to work in teams. We now see sharing Tablet PCs as an opportunity to help students develop team skills. There is also potential to design Tablet PC questions that encourage students to reflect on roles in the partnership.

We appreciated that students reported concerns about sharing but we were surprised that we had not observed the issue. We note the similarity to the study of Greenwood and Haughian (2006) in which male students dominated the use of the electronic pen but teachers did not observe this until video footage was reviewed. This issue reminds us of the importance of giving students an opportunity to provide anonymous individual feedback to the teachers.

4.6 Encouraging students to submit answers

Although students consistently worked hard when answering questions, we observed that students did not always submit their answers. One student commented on this but couldn't see a satisfactory solution. We observed that being able to submit answers anonymously on Tablet PCs did enable some students to contribute in class when they would not otherwise have so done. This is consistent with Anderson and Linnell (2009) who found that Tablet PCs could overcome barriers that may prevent students contributing in class. However, other students were sometimes reluctant to submit their answer and this is consistent with the findings of others, for example Koile and Singer (2008) reported that only 56% to 78% of students submitted their answers. Although submissions were anonymous, some students may still have been reluctant to have them displayed to the class if they were unsure about their correctness. We experimented with insisting that every pair submit an answer and this showed that sometimes students had not quite finished their answer. We now make more effort to discuss the submitted part of incomplete submissions.

Submitting answers on Tablet PCs appears to overcome some barriers such as being unconfident about speaking but using Tablet PCs may introduce other barriers because students know that their answers may be displayed to the class. There is a need to investigate the reasons that students didn't submit their answer in order to work out how to improve the number of answers submitted.

4.7 Taking notes

A number of students wrote that a disadvantage of using Tablet PCs was that they didn't have notes to take away. It was easy for students to save their work onto their pen drive but we observed only a few students doing this.

Being able to save notes easily can be an advantage of using Tablet PCs (Roy and Luthra 2008) so there is clearly potential to help our students experience this benefit. We could offer more specific guidance and provide more time for students to annotate and save their answers. However, there is also potential to investigate student note taking further as we mainly used Tablet PCs for student exercises but there is potential for students to learn more about how to annotate them to convert them into useful study notes.

4.8 Students who prefer pen and paper

There was usually one student in each class who preferred not to use Tablet PCs and instead wrote the questions and answers on paper. It is interesting that although all students were studying computing, a few did not feel comfortable using Tablet PCs to learn mathematics. One student explained: "I don't use the tablets, call me old school but I prefer my own notes on paper." Most of these students found learning mathematics challenging but achievable. These students appeared to understand how they learnt and were unwilling to risk failure by learning to use a Tablet PC at the same time as learning mathematics. However, these students took advantage of the peer instruction as each of them sat with a pair of students using a Tablet PC and joined in the discussion of questions.

4.9 Technical problems

There were a number of technical problems that persisted beyond the first few lessons. On average, there was approximately one technical problem per lesson and most problems were fixed very quickly.

Although technical problems only occurred occasionally, about one third of students (23 out of 71) reported that technical problems were a disadvantage of using Tablet PCs although a few acknowledged that there were not many of these, for example, "odd technical glitch". It appears that technical problems

distracted students from their learning. While this was to have been expected for non-technical students, it is interesting that so many computing students found technical problems distracting. This result highlights the importance of providing students with an environment that is free from distractions such as technical problems.

5. Contribution and evaluation

The contribution of this study is two-fold: firstly, it provides evidence in a real class situation of students' perceptions of learning benefits from using Tablet PCs for interactive learning activities, and secondly, it documents issues that students raised and makes suggestions that should help other teachers intending to use Tablet PCs in a similar way. These suggestions are summarised as a set of recommendations in the "Conclusions" section of this paper.

Although this was a small-scale study, many students wrote thoughtful and insightful comments about the impact that using Tablet PCs had on their learning. Therefore, many issues could be investigated.

6. Conclusions

This study provides support for the many studies that have shown that using Tablet PCs improves student engagement (e.g. Mauch 2008). It also supports the findings of Linnell et al. (2007) who reported learning benefits for students from the instructor's feedback about the submissions.

And it was not just the students who were more engaged; we found that introducing Tablet PCs invigorated our teaching. We enjoyed seeing the students actively engaged in working on questions and observing the peer instruction that occurred. We also felt empowered to provide relevant feedback by seeing students' progress in their submissions.

It was not just the students who were learning; the teachers were learning too. We found that as teachers we needed to learn to choose suitable pedagogy, respond effectively to students' submissions, minimise technical problems, and integrate the technology smoothly into lessons in ways that catered for the varying learning needs of students.

It is important that lessons are structured to take advantage of the benefits of using Tablet PCs and to minimise any distractions from learning caused by introducing a new technology into class. The results of this study can be summarised by the following set of recommendations for teachers:

- Experiment with and select a suitable pedagogy for each activity.
- Consider how students should take notes from Tablet PC activities.
- Create a structured start to lessons by beginning with a review question.
- Provide additional questions for students who finish a question very quickly in a way that does not distract others.
- Try to provide feedback on as many student submissions as possible, including alternative strategies and incorrect submissions.
- Use the opportunity to help students learn to work effectively in pairs or groups.
- Seek anonymous individual student feedback on the impact of using Tablet PCs.
- Do everything you can to minimise distractions caused by technical problems.
- Plan alternative learning activities in case technical problems cannot be fixed quickly.

Teachers planning to use Tablet PCs interactively in classes can consider these recommendations and learn from our experiences. The rewards are being able to apply well established pedagogies such as immediate feedback, peer instruction, meaningful discussion, active learning, engagement, review, and formative assessment in new and effective ways.

The main limitation of this study is that it was conducted with only 71 students in one specific situation of a mathematics course for computing students in a polytechnic in New Zealand. However, the learning benefits should apply to other subjects that suit a similar pedagogy and it should be helpful for teachers to think about our recommendations when planning to use Tablet PCs with classes.

Thus, in this paper we have reported the main learning benefits of using Tablet PCs and also discussed issues for teachers to consider and made recommendations. In addition, we have identified the need further to investigate ways of improving student note taking, improving the number of submissions, encouraging effective team work and catering for faster students.

7. Acknowledgements

We acknowledge and appreciate a grant from the Hewlett Packard Technology for Teaching Initiative that was used to purchase a class set of Tablet PCs.

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Taking ownership of e-learning: a transferable mentoring model

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This paper addresses the uptake of e-learning in a research-intensive university in the UK and proposes a transferable model of support for effective e-learning development. We describe the context in which professional development takes place, and the processes involved during a two year "ePioneers" initiative which aimed to move the School of Education at the University of Nottingham to majority adoption of e-learning practices. The School placed control of e-learning development in the hands of the academic and administrative staff who identified "quick gain" projects where e-learning might enhance the learning experience of students. Outcomes included gains in confidence and a participant sense of ownership of e-learning. The emergent mentoring model for organizational change in e-practices is based on action research, and has been demonstrated as being transferable to other Schools in the same university.

Keywords: *case study collaboration, CPD mentoring methodology, e-learning uptake, professional development, quality enhancement, quality improvement, staff development, shifting ownership*

1. Introduction

The School of Education at the University of Nottingham is not alone in having some staff who are active with e-learning, and others who are not. E-learning was perceived to be the domain of early adopters and specialists, and not a mainstream activity. However, the teaching culture at this research-intensive university is thriving - an internally-oriented dissemination project, PESL (Promoting Enhanced Student Learning), showcases the teaching activity of more than 430 staff, covering a diversity of teaching contexts and addressing a range of student learning issues in a culture of reflective practice. Common caricatures of those staff who use lectures in their teaching repertoire as simplistic instructivists using "warmed-over approaches from the past" (Barnes & Tynan, 2007) are clearly unfounded here. The School of Education formed an E-learning Strategy Group who undertook both to understand the motivations and aspirations of their staff, and to devise a mentoring programme to support wider use of appropriate technology, based on their findings.

2. Background

2.1 E-learning strategy and policy context

E-learning is a focal point in UK Higher Education policy, as demonstrated by the array of initiatives around e-learning (Conole et al., 2007b). The Higher Education Funding Council for England (HEFCE) Strategy for E-learning (Beaty et al., 2005, updated in 2009) aimed to embed and maintain e-learning in Higher Education Institutions (HEIs) in a sustainable manner within a decade. The HEFCE strategy maintained that e-learning has been criticised in the past for its focus on technology and the provision of materials, and that a shift of focus to learner independence mirrors developments in pedagogy and the increasing need to support diversity and flexibility in higher education. The strategy placed an emphasis on e-learning becoming a "normal or embedded part" of teaching activity. Conole et al. (2007b) argue that the increased emphasis on e-learning has produced interventions that focus on policy development, staff development and organisational culture change, with interventions categorised as educational, technological or organisational. Educational interventions, mainly addressing approaches to teaching and learning, are reported as having shown a far-reaching impact on institutional change (Conole, 2007).

Like other UK HEIs, the University of Nottingham has set out its own strategy for e-learning which takes account of the HEFCE strategy and sets out organisational, technical and educational priorities for activity and investment.

At School level, the challenge was how to establish routes to advance e-learning from the periphery of activity performed by an interested, pioneering few, to a principal activity supporting all activities that enhance the learning experience. The School of Education formed an E-learning Strategy Group tasked with providing strategic direction and vision for e-learning across the School with the intention of incorporating the use of e-learning into the learning and teaching agenda. The group comprised members of academic, administrative and support staff in an attempt to involve the structure and processes of the school at all levels.

2.2 Continuing professional development (CPD) context

Implementing the broad aims of strategy and policy documents inevitably asks for change at the level of the individual practitioner. Staff development activity in this context is often intended as facilitation for the change management process where the language of strategy and policy documents needs translating into the working contexts of the organization. This translation is not always straightforward given that strategy documents are often "impersonalized texts where staff are largely absent and students are objectified" (Smith, 2008).

Centrally created policies on e-learning uptake often result, in UK HEIs, in centralized e-learning units, usually non-teaching, being tasked with research, the selection, implementation and support of systems and staff training. The emphasis may be in one direction more than the others, and the unit may be located with a technology, teaching quality, or academic development context depending on the institution.

In Land's (2003) analysis of the roles of educational development activity in the organization, this positioning of responsibility for e-learning with a central unit might reflect a "managerialist" approach, where the aim of the intervention is to effect policy as determined by management. As Elton (1999) argues, change needs to have both a bottom up and a top down approach, where the former uses its power to facilitate the work; and the latter shares the knowledge which prospers under suitable working conditions. In Land's analysis, this might add a need for a "broker" or "romantic" approach to address the individual's development within the organizational aims.

Where resistance to change on the part of those who teach is ascribed to a lack of vision, lack of understanding of the potential of technologies, or an outmoded approach to teaching; it may indicate a greater emphasis on a top-down implementation of centralised objectives, with attendant identification of barriers to progress, rather than a bottom-up approach of recognizing the strengths and ambitions of individuals and fostering potential in their specific context.

In the literature on e-learning and learning technology, and predominant in the policy statements of funding bodies, are phrases that imply that technology has indubitable potential to change teaching for the better, phrases such as "harnessing the potential of..." and "*will* enable learners to..." [our emphasis]. When employed in De Freitas and Oliver's (2005) "Fordist" model of change, this language can create resistance by implying that alternative approaches are better than current practice without negotiation or understanding of current practice and its rationale. De Freitas and Oliver argue that the complementary "community of practice" and "discourse-oriented" views of change place the emphasis on local re-evaluation of the meaning of policy statements to create an interpretation that is credible and useful. In these models the reality of making decisions about teaching comes to the fore and credibility of arguments about value arises from honest, balanced accounts from peers.

In the School of Education at Nottingham there is clearly a healthy approach to change and innovation in teaching as evidenced by the range of challenging technology-supported projects (e.g. HEFCE-funded e-China project, JISC-funded Teaching and Learning Observatory, International postgraduate distance courses). The potentially credible peers with experience were in place to accompany the introduction of an e-learning strategy.

As Kirkwood (2009) highlights, however, "the use of ICT does not, *in itself,* result in improved educational outcomes" [original emphasis], and that even when innovations are driven by teaching needs, appropriate support is also necessary for change to take place. For the School of Education at Nottingham, mentoring fitted the culture as an appropriate support route for those new to e-learning.

2.3 Mentoring approach

Mentoring is a complex construct open to wide interpretation in diverse educational contexts (Bova and Phillips, 1981; Bryne, 1991; Ehrich, 1995; Darling, 1984). Poulsen's (2007) notion of a 'mentor' is based on comparisons between mentoring practices in the USA and the UK with the US model focusing more on the role as a career sponsor and door opener, and the UK model focusing on the role as a guide, counsellor and coach. Klasen and Clutterbuck (2001) argue that a mentor's role is to support the transition for enhancement for personal or career and development. For the ePioneers initiative, the mentoring role was to support this transition using elements of both the US and UK models as appropriate to the individual's needs and the mentor's experience.

The uptake of innovation is described by Rogers (2003) as a diffusion process with the participants at various stages of adoption categorized as "innovators", "early majority adopters", "late majority adopters" and "laggards". In this framework, he maintains that early adopters "decrease uncertainty about a new idea by adopting it and then conveying a subjective evaluation of the innovation to near-peers through interpersonal networks." (Rogers, 2003:283). This model of development of expertise across the school informed the selection and briefing of mentors as near-peers in the ePioneers initiative.

3. Developing the ePioneers programme and transferable model

3.1 Programme development and research

Alongside the practical aim of developing e-learning in the school, the authors studied the processes involved during the initiative's 2 year period. Individual face to face semi-structured interviews were held with the ePioneers and mentors allowing the participants to reflect on their role in the projects and the construction of the emerging e-learning community. One of the authors (Elaine Arici) was a member of staff in the School of Education at the time and acted as project co-ordinator for the duration of the project.

The ePioneers programme is described below, often using quotes from participants as an authentic voice of the experience. [Footnote: Short interviews with programme participants, and many programme documents, are available on the ePioneers website at http://www.nottingham.ac.uk/epioneers].

3.2 Audit of e-learning in the School

The School's E-learning Strategy Group began by investigating attitudes towards e-learning and knowledge of activity within the School using both questionnaires and interviews. As well as the expected barriers to engagement, such as time and confidence, findings included a critical awareness with staff responses including comments such as "Yeah, we're aware of new learning technologies, but it doesn't always work, does it?" and "It takes a lot of effort to get the things working, and I'm not sure of the value". The openly sceptical attitude is perhaps an expression of doubt based on prior (disappointing) experience and/or an evaluation of e-learning as having limited potential in their particular context.

3.3 The ePioneers programme

The Chair of the E-learning Strategy Group was keen for academics to take ownership of how e-learning was developed in the School: "The very people who need to be the designers of these tools, because they understand the context much better than some of the technical experts, they were the ones that needed to be in there, leading.". Rather than impose, from the top-down, that staff should be finding uses for particular technologies in their teaching, the group wanted to draw on the enthusiasms and the interests of people who they knew were starting to work with technologies, to identify those people and then to support them. For the E-learning Strategy Group it became clear that "we were working away as individuals, typically

as academics, doing our own thing on our own courses, when we could have been learning an enormous amount from each other, and working together." The approach echoes Carlopio's (1998) emphasis on shared decision-making, common vision and collaboration in a move to establish sustainable change.

Encouraging and supporting staff through mentoring seemed a natural choice for the School with their familiarity with it in a range of contexts, including initial teacher education and the experience of new teachers in schools.

3.4 Invitation to participate

The E-learning Strategy Group members put up posters in the School and sent round an email outlining the programme and inviting participation in an initial lunchtime meeting for interested parties. The key was that it was something quick with some money to outsource expertise if required.

Interested members of staff were invited to submit a short proposal. Approximately 50 members of staff attended the two organised launch meetings, and from them, 19 project ideas were submitted for consideration. The members of the E-learning Strategy Group did not want to turn anybody away, so projects and ideas were grouped together.

There was a small amount of funding available as an enabler rather than a prime motivator for engagement.

3.5 Participant projects

The aim of the ePioneers programme was to normalise e-learning for those who are not early adopters. Not unexpectedly, the projects themselves were not groundbreaking in e-learning terms, although they were new areas for those involved and thus they were innovations for the participants. Typical projects included academic staff addressing known teaching issues by using WebCT, podcasting or e-portfolios for the first time. Support staff projects featured the development of a marketing email newsletter, setting up an online support network for distance learning postgraduate students, and an investigation into the potential for an online research application tracking system to aid efficiency in decision-making across the Institution.

3.6 Mentor selection and allocation

Potential mentors were selected from within the School by the E-learning Strategy Group using the audit results and existing networks to identify suitable people.

The mentor's role was to provide support, advice and guidance in the use of technologies. It wasn't necessary that mentors were already experts in a proposed project area, but they needed to have some experience, or they needed to want to update themselves or upskill themselves in a particular area.

It was critical that mentors were aware of the need to help people solve the problems themselves. Here their peer experience of having been through the development process was valuable. A key quality was to have empathy for whence a colleague is starting, and to recognise that incorporating technologies, no matter how small a step it may seem having gained some experience, might be a big hurdle for people who are new, or who have found it problematic in their first attempts.

ePioneer participants were paired with a mentor who had the appropriate skill and expertise to suit the project. All participants were informed and the projects were launched with a meeting where all participants came together to begin to plan their work.

3.7 Community development

Regular face to face meetings were held between all participant groups to encourage the ePioneers and mentors to discuss their projects in an informal setting and thus develop community formation through mutual interests in the projects. The meetings were usually no longer than one hour so that they did not interfere with the normal workload of the participants.

At monthly intervals email alerts were sent out to participants in order to maintain the momentum of the projects by asking for updates on progress.

The mentors held two focus meetings - the first a month into the launch of the programme and the second half way through the first year to share thoughts and emerging support strategies in their roles within their projects.

The E-learning Strategy Group hosted a series of 'Show and Tell' events to raise awareness of the projects amongst the ePioneers, the School more widely, and leading e-learning practitioners in the University. Each project provided an A3 poster depicting their project content and outcomes and a 500 word report for display. Events, including conversations with participants, were videoed for wider dissemination.

The Group also attempted to generate an online community, but it didn't prove to be an appropriate environment for reflective discussion of professional development, as people didn't feel they could talk openly about what they were doing. One participant had concerns about the permanency of writing online: "Okay, you can edit it, but it's there for people to unpick, whereas discussing something, sharing your feelings, may be admitting more failure, or more concerns, or more - it's much better to do that face-to-face." For another, "there's no real dialogue, at least in my thinking, in posting messages on the web".

4. Outcomes

Most of the projects started by the ePioneers participants came to a successful conclusion in terms of achieving their original goals to a greater or lesser extent. Those that did not were affected by external factors such as staff moving jobs, or compliance with central systems requiring the alteration of project objectives. In these terms, the ePioneers programme was effective in supporting individual projects in the School. More importantly, however, there were School-wide benefits identified by participants on the scheme, over and above the individual project outcomes.

Alongside specific project outcomes, wider themes emerged:

- staff gained confidence in identifying relevant e-learning approaches;
- evaluating technology is becoming embedded in normal practice;
- the School is building its capacity to own its e-learning developments.

In terms of professional development for individuals, one participant noted that "what was important was the whole the independence and the autonomy that I got through being involved in the ePioneers project." The involvement of a wide range of staff, and a focus on ongoing contact and support has created a wider network. As one mentor notes, "we now have a group of people, learning technologists, as well as the mentors around the school, as well as the people who were involved in those projects who are now beginning to act as mentors". The E-learning Strategy Group are convinced that "it has helped individuals to become more knowledgeable and more confident as users of e-learning approaches, and that helps the school towards its organisational goal of becoming more of an e-learning school."

5. The transferable mentoring model

The Initiative had a strategic aim embedded in e-learning change management within the wider University and contributed to its institutional e-learning Strategy. (Rogers 2003) points out that diffusion of innovations theories provides an ideal framework to explain how new ideas and technologies are spread and adopted in a community. (Nichols 2007) explains that the ultimate aim of e-learning diffusion is the implementation of e-learning that is sustainable and suitable within a given institutional context. (Carlopio 1998) notes that the implementation of change is not a linear process and progresses in stages over a period of time. Furthermore, the commitment from stakeholders is achieved through shared decision-making, common vision, collaboration and the establishment of support structures. The aim of the proposed model is to provide a tool to support the diffusion of e-learning through a shared and negotiated vision. The model is an evolving example of e-learning diffusion implementation albeit in its early stages.

The proposed model is based on a mentoring approach to supporting e-learning practices. as compared to the more established roles of mentoring discussed in the first part of this paper.

The overview of existing e-learning models conducted by Mayes and de Freitas (2004) outlined e-learning approaches in relation to pedagogical perspectives: instructional systems design, constructivism and communities of practice. The Centre for Studies in Advanced Learning Technology (CSALT) networked learning model (Goodyear 2000) based on constructivist and communities of practice principles, is aimed at tutors in higher education, providing a pedagogical framework and overview of broader issues around networked learning. Although the CSALT model distinguishes between the tasks designed by the tutor and the activities carried out by the learner, it is sensitive to organizational context and asserts its importance in higher educational settings. The CSALT model endorses the context of our proposed model with its focus on real-world practices and the general ethos of social and organizational change with the introduction of new technology to learning environments.

5.1 Model description

The emergent framework of the model connects main challenges within the outer circle, namely: leadership; contextualisation; project duration; and ownership of change (Figure 1). The outer circle provides the conditions for the mentoring processes and project activities within the inner circle. The inner circle denotes the processes that facilitate this change through the e-learning projects supported by the mentor.

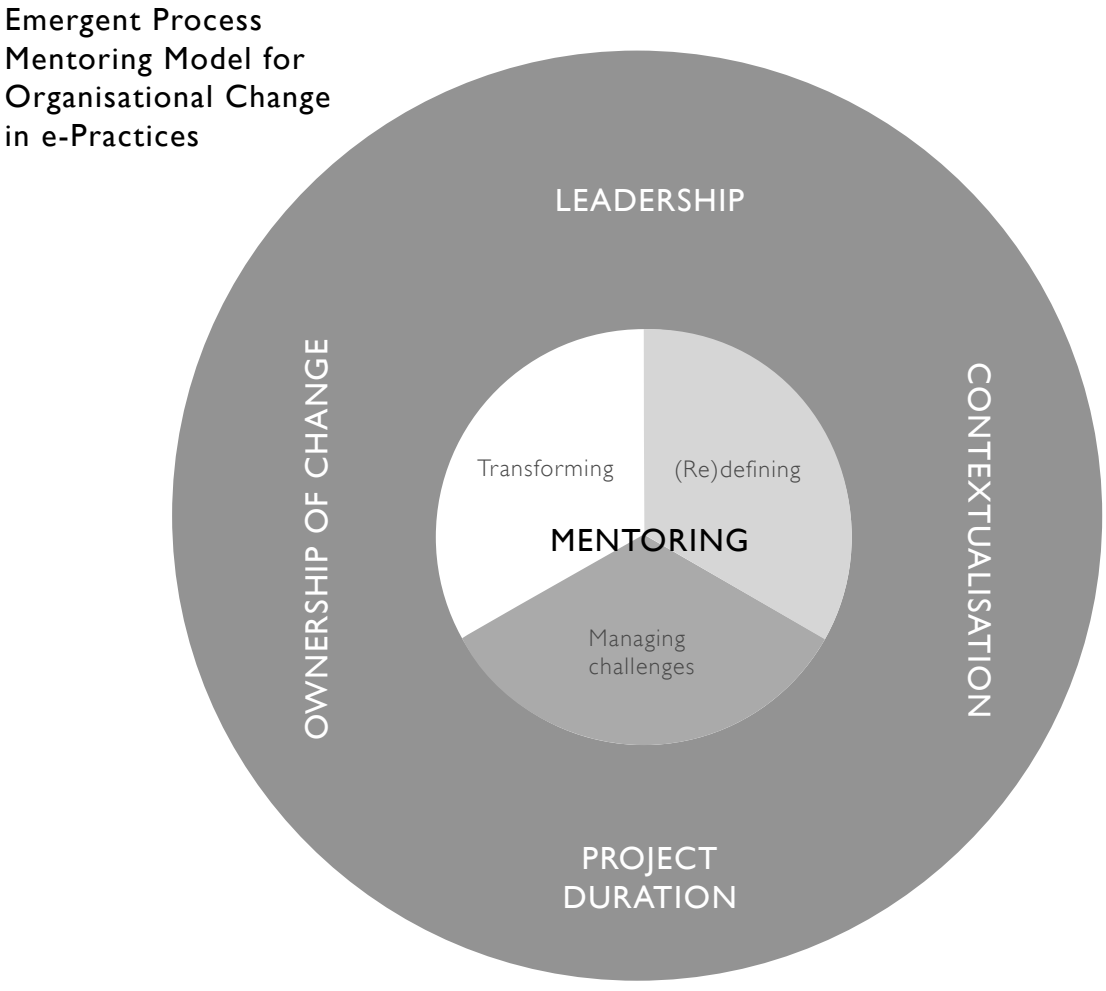

Figure 1. Conditions for favourable mentoring implementation

5.2 Outer circle processes – conditions for change

The outer circle describes the challenges for change identified through the establishment of the players and setting the conditions for the projects to proceed.

5.2.1 Leadership

According to (Elton 1999) change needs to have both a bottom up and a top down approach, where the former uses its power to facilitate the work; and the latter shares the knowledge which prospers under suitable working conditions. (Hegarty et al. 2005) also argue that timely and appropriate staff development within a supportive and strategic institutional culture is very influential in the adoption of e-learning. The ePioneers leadership approach in the model is two-fold: a bottom-up aspect to specify the nature of appropriate change and develop and implement it; and a top-down approach to create the conditions to enable meaningful and appropriate change to occur. In this context the former consists of technical, administrative and academic staff proposing projects using e-learning to enhance the student learning experience through their own work practices. The latter are the identified change agents i.e. school managers, early adopters and identified mentors together with the support of senior management and/or school managers that consider the needs of the school with e-learning developments. Our model provides the conditions for e-learning approaches to be developed through the projects identified by the ePioneers for development.

5.2.2 Contextualisation

The context is embedded in the School plan or similar, where in our case e-learning was a recognised target. A needs analysis performed within the School or department provides tangible outcomes to form the basis of e-learning planning and developments in specific contexts. In our case, we gathered data on existing good practice of e-learning and perceived development needs of colleagues through a questionnaire audit. In addition, the e-Strategy group identified six colleagues with key areas of responsibility within the School to be interviewed in order to obtain a baseline overview of e-learning at the current time. The findings in a written report formed the basis for a successful bid for funding for a School e-learning initiative to be supported by the University's Learning and Teaching Development Fund.

5.2.3 Project duration

The duration of the project needs careful monitoring and support. The ePioneer Initiative set an initial duration of two years based on the funding bid. However, the longer term aim is to make e-learning part of the mainstream function of the School and meet School Plan aims (2005-2009). These conditions will therefore provide the basis for e-learning activities to continue to be developed within normal working practices in the School beyond the duration of this particular initiative. (White 2007) points out the usefulness of the pump-priming role of external drivers from organizations such as HEFCE, Joint Information Systems Committee (JISC), and the Quality Assurance Agency for HE (QAA) in the change process, but sustainability of change is problematic. (Rogers (2003:429) also considers sustainability or "institutionalisation" of innovation and argues that collective innovation decisions are more sustainable that top-down approaches.

It is vital that the momentum of the project is maintained through regular contact of the players involved. This may be achieved through the identification of a coordinator to monitor and encourage participants and help to maintain the balance between project and individual core working practices. Regular reporting through team and School meetings also helps to maintain the momentum and foster the notion of developing e-learning communities of practice.

5.2.4 Ownership of change

This stage focuses on processes which facilitate and encourage the ePioneer to take ownership of their project and become less reliant on mentor input. This stage concurs with the "routinizing stage" in Rogers' Five stages in the Innovation process, (Rogers (2003:420). In this stage innovation is incorporated into the regular activities of the organization, losing its separate identity. Indicators of this stage are factors such as project integration into normal working practices, take-up of professional development opportunities and when ePioneers are confident to embrace other e-learning opportunities as they occur.

5.3 Inner circle – processes for change

The inner circle outlines the conditions for mentoring identified through the development of the ePioneer projects, Figure 2. The relationship between the ePioneer and mentor contribute to the overall process to bring about ownership of change.

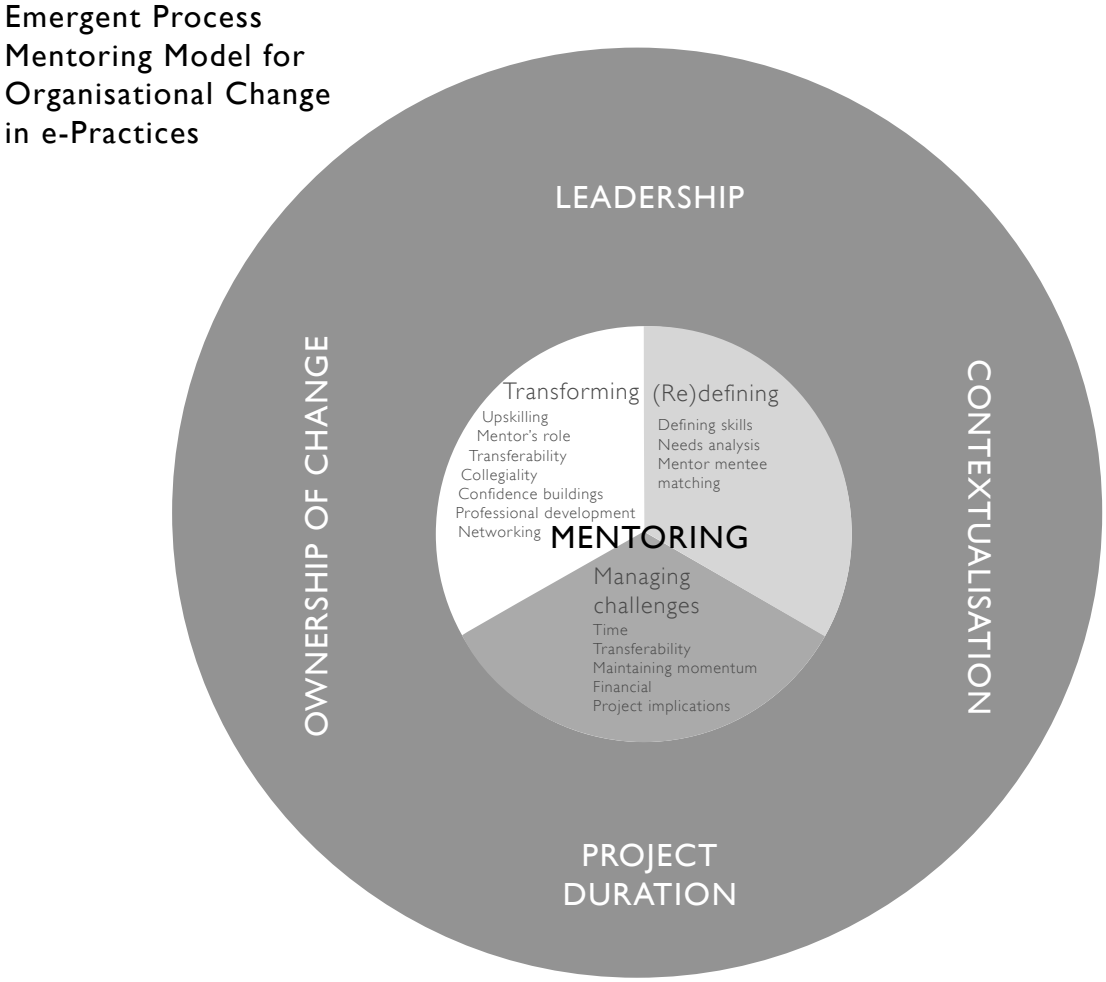

Figure 2. Outcomes meeting challenges for mentoring processes

5.3.1 (Re)defining mentor and ePioneer roles

The needs of the project and the skills required to support it are identified. Mentors with relevant skills and expertise are matched with the ePioneers. Mentors and ePioneers renegotiate their roles and skills based on the evolving needs of the project as it develops. This developing relationship provides the basis for mutual support through the process of the development of the project through its duration.

The mentor's role tended to be broad and varied with each project and participant with the four roles of pedagogic advisor, implementation advisor, facilitator and motivator emerging from these interactions.

1. Mentor as pedagogic advisor
   In peer-peer interactions between (academic) ePioneers and (academic) mentors, discussion covered the learning and teaching scenario, the specific learners, and their specific needs. One mentor highlighted how the advisory role relies on discussion and sharing and hence the meetings became conversations, not about technology, but about aims for their students and how their plans might improve student learning.

2. Mentor as implementation advisor
   When members of staff are dealing with new technologies and a whole set of jargon that they are not familiar with, it can prevent them from asking questions and approaching people. One ePioneer noted how her mentor would phone technical support during their meeting, on speakerphone, so they could all hear, join in and become valid participants.

3. Mentor as facilitator
   The mentor might only be the first port of call, with the door-opening role demanding an understanding of the needs of the people that you were working with, and looking at what existing networks might help and support the implementation of the individual projects.

4. Mentor as motivator
   Both mentors and their ePioneers recognized that the sense of being valued is very motivating. It happened because they were exploring the same issues together. The collaborative basis and the shared discussions were a powerful way of motivating colleagues by colleagues. One mentor confirmed that part of the role was to confirm that what they'd done was actually a big step forward.

Across these roles mentoring was a cycle of generating ideas, trying them out, critiquing them, and then going on to the next stage. The adoption of a new mentoring role by staff within a collaborative development culture might be considered as the type of change in professional roles as identified by Conole et al. (2007a), Gosling (2001) and Oliver (2002) as indicators of the impact of technology.

5.3.2 Challenges

Managing the challenges through the developmental stages of the Initiative is variable and there are several areas identified:

- Time – pressures and constraints of core work demands.
- Transferability – challenge to move project ideas forward
- Maintaining momentum – boosted through mentor support, group camaraderie and project coordinator
- Finance – an incentive to project development but not essential

5.3.3 Transformation

The transformation stage sets the conditions for the ownership of change in the outer circle. This stage is equivalent to the clarifying stage in Rogers' Innovation process (ibid: 427) where innovation is more widely used and its use more familiar. It is within this stage that the role of the mentor is of lesser significance within the process. Outcomes within this stage see how the projects can be further integrated within normal working practices. There is evidence of further collegiality within the e-learning community, within the project and also within the School as there is evidence of more e-learning expertise cascaded to colleagues. In addition, confidence developed through the project process is identified through personal and professional development opportunities pursued by the ePioneers in bids for external funding for ideas emerging from ePioneers projects.

6. Transferability

The School of Nursing has identified a need for an innovative strategy to enhance recruitment and retention of students in the global market using e-learning solutions to enhance the School's competiveness. Their focus was on providing a vision and a framework for the timely and appropriate use of new technologies to enhance the learning and interaction of nursing students with their peers, lecturers and mentors.

Like the School of Education, the School of Nursing has adopted a mentoring approach to supporting staff with e-learning initiatives that have been instigated by staff members. Staff members interested in using technologies within teaching and learning applied to be mentors and were appointed to support staff within the different Divisions of the School. This School Initiative is supported by the Director of e-Learning and the mentors coordinated by a Senior Lecturer seconded into the role to manage the duration of the project 2008-2013.

Asked about the baseline impact of the project, the Director of E-learning commented that:

> *"I may be biased, but highly successful because within the e-mentors themselves you can see a massive personal development, but also, you can see within the different Centres that they are beginning to take on more technologies."*

7. Conclusion

This paper has sought to move away from presenting the results of institutional e-learning implementation and towards identifying the process stages i.e. e-learning in action. This is located in an initiative attempting to embed e-learning within the normal working practices of a large School in an HE context. The emergent model shows how a connection can be made between staff willingness to develop professional practice and the institutional or local aims as may be outlined in an e-learning strategy document.

The findings suggest the role of the mentor is pivotal in supporting the progression of e-learning processes in this context. E-learning community formation is desirable and maintained by appropriate conditions and support set up within the projects.

The emergent process mentoring model for organisational change in e-practices provides a platform for evaluation of the mentoring process in other Schools and departments wishing to develop e-learning in their own context.

8. ePioneers initiative website

http://www.nottingham.ac.uk/epioneers/ Through 23 video conversations, and supported by 29 documents, 11 School of Education staff offer a balanced view of e-learning adoption.

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Where angels fear to tread: online peer-assessment in a large first-year class

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In the context of widening participation, large classes and increased diversity, assessment of student learning is becoming increasingly problematic. Providing formative feedback aimed at developing student writing proves to be particularly laborious. Although the potential value of peer assessment has been well documented in the literature, the associated administrative burden, including that in relation to managing anonymity and intellectual ownership, makes this option less attractive, particularly with large classes. Despite the potential of the Workshop module of Moodle for automating the logistics associated with peer assessment, the uptake thereof within the higher education community seems to be insignificant.

Addressing the conference theme of increasing productivity and effectiveness, whilst mitigating risks, this small scale case study reports on the use of the Moodle Workshop module for formative assessment of students' individual work in a first year introductory macroeconomics class of over 800 students. Data was collected through an end-of-course evaluation survey of students. The study found that using the feature-rich Workshop module not only enabled us to address many of the practical challenges associated with paper-based peer assessments, but also provided a range of additional options for enhancing validity and reliability of peer assessments that would simply not be manageable with paper-based systems.

Keywords: *challenges for education, efficiency, effectiveness, larger group sizes, mitigating risk, productivity, quality, quality improvement, risk uptake, assessment, case study, technology, tools, uptake, VLEs, peer assessment, moodle workshop, module feedback*

1. Introduction

Topping (1998, 250) defines peer assessment as "an arrangement in which individuals consider the amount, level, value, worth, quality, or success of the products or outcomes of learning of peers of similar status". For the purpose of this paper, we use the notion of peer assessment to refer to the assessment of *individual* work, rather than *group* assignments (cf. Crocket & Peter (2003)). The merits and drawbacks of peer assessment for enhancing student learning are well documented in the literature (see, for example, Gibbs (1999), Hanrahan and Isaacs (2001), Ellis (2001), Pope (2001), Race (2001), Rust (2001), Salemi et al. (2001), Ballantine et al (2002), Crockett and Peter (2003), Smyth (2004); and Mento (2004). As a unique form of writing responding, peer assessment used formatively promotes writing as an iterative process and generates contextualised feedback at the draft stage of the writing process which has the potential to contribute significantly to their learning (Paxton 1997). Often, however, teachers of large classes find practical issues related to the implementation of peer assessment prohibitively cumbersome. Although technological solutions to such administrative and practical challenges have been available for some time, the literature currently offers surprisingly little empirical research exploring the use and impact of such online systems. This paper aims at addressing this gap by exploring the potential and challenges of using technology to facilitate a peer assessment process in a large first year macroeconomics class using the *Workshop* module of the open-source learning management system, *Moodle*.

Conscious of a need to focus on technology without allowing it to become *the* focus, we report not only on the possibilities afforded by the Workshop module by describing the way in which we set up the peer assessment exercise, but also on the student experience of the process.

2. Background

Against the background of the current socio-political context in South Africa, the ideals of social justice, equity and redress of historical imbalances have led to the massification of the higher education system. Despite a cautious approach to increasing student intake at Rhodes University, many classes at the institution have doubled in size in recent years, resulting in assessment and providing formative feedback on student work becoming some of the biggest challenges for lecturers.

In responding to similar challenges, many Economics departments globally have opted to switch to multiple choice questions (MCQs) in an attempt to reduce both the workload of lecturers as well as turn-around time for feedback. However, the Department of Economics and Economic History at Rhodes University maintains that, while MCQs can be used effectively to test the grasp of key concepts and definitions and the application of specific formulae and so on, essay type questions are essential for assessing the development of coherent arguments and "line of reasoning" when applying economic models to real data or case studies. As a "writing intensive course" in which "writing is used as one of the major pedagogical tools for achieving specified course goals and objectives" (Grauerholz 1999), Economics 102 therefore requires students to submit twelve weekly written tutorial exercises for formative feedback and two essays (assessed by trained postgraduate student tutors) for summative assessment per semester. Test and examination papers use both MCQ and essay formats.

A parallel challenge resulting from increasingly large classes relates to the growing number of students whose home language is not English. Analysis of student performance in the Department shows that English second (or third) language speakers perform less well in essays and essay type questions than students who are English first language speakers. This has significance for the South African higher education system's widening participation agenda as, in the 15 years since the transition to a democratic government, increased access for students from previously disadvantaged communities (for whom English is a second or third language) has not been matched by corresponding throughput rates (Scott, Yeld, and Hendry 2007). In this context, it therefore becomes imperative to explore the affordances of technology to develop student writing.

By providing a structure for iterative revisions of student writing in response to feedback, online peer assessment becomes a potentially powerful strategy for supporting the development of student writing. Some of the benefits of using technology to manage peer assessment include the automation of many of the administrative logistics such as the submission of essays, anonymising and random distribution of essays, making feedback available and calculation of marks. In contrast, however, the threat to intellectual property rights inherent in the digital format of online texts needs to be managed if students are not to lose confidence in the process.

A number of dedicated online peer assessment systems that have been developed recently include *PeerMarkTM / WriteCycle*® of the text matching system *Turnitin*™ (Draaijer and van Boxel 2006); *Aropä* (Hamer, Kell, and Spence 2007); *CAP* or *Computerized Assessment with Plagiarism / Computerised Assessment by Peers* (Davies 2000; Davies 2009); *CPR* or *Criterion Peer Review*™ (Doiron 2003); *PASS* or *Peer Assessment Support System* (Li and Steckelberg 2005); and *peerScholar,* (Paré and Joordens 2008).

Originally written by Ray Kingdon, the *Workshop* activity is probably the most sophisticated tool in Moodle (Cole 2005). While managing all of the "standard" processes of online peer assessment mentioned above, the Workshop module includes a vast number of additional options, all of which are aimed at increasing validity and reliability. Arguably the most valuable features of the Workshop module are those that are designed to scaffold (inexperienced) students when assessing their peers' work. Teachers have, for example, the option to present students with any number of exemplar assignments (e.g. good and bad examples), which students can assess and then compare with the teacher's "model" assessment. This provides the students with some way of "calibrating" their judgments against the teacher's expert opinion. Similarly, the built-in assessment criteria function ("scoring guides") supports students in assessing a piece of writing thereby enhancing the validity and the reliability of their assessments. Teachers can choose from five "grading strategies" presenting a range of ways of working with assessment criteria, one of which is assessment rubrics or grids. In each of the grading strategies teachers can choose the number of "assessment dimensions" or criteria to be assessed.

Finally, the flexibility in which final marks can be weighted and calculated is a very powerful feature of the Workshop module. Apart from receiving grades for their submitted essays (from self, peers or teachers), students can also receive a grade for their assessments of the exemplar essay(s) and/or of their peers' work. In setting up the calculation of the final marks the teacher can set weighting for bias as well as for reliability. Similarly, weightings for teacher assessments of essays, peer assessments of essays, and grades for student assessments can be set independently before final grades are released.

The Workshop module works in seven stages: (1) Workshop is set up by the teacher (topic and instructions, grading strategy and assessment criteria); (2) Examples from teacher (optional); (3) Submissions by students; (4) Self-assessment by students (optional); (5) Peer-assessment (optional); (6) Assessment by teacher (optional) of student submissions and of student assessments; and (7) Final grade aggregation, which may consist of a mark for submissions as well as a mark for assessments (Mudrák n.d.). Since the Workshop Module has not been maintained for some time, various issues which made the use thereof less satisfactory started to surface. From a pedagogical perspective, the biggest concern was that the way in which the final grades are calculated could not be adequately explained. Other concerns centred on integration with Moodle's Gradebook, the user interface and usability, and the overlapping of submitting and assessing phases which compromised equal allocation of student essays. At the time of writing, the Workshop module was in the process of being completely rewritten for Moodle 2.0 (Anon n.d.) which was due to be released on 20 July 2010 (Anon n.d.). It is important to note, however, that we have been using the "old" version of the Workshop module for our peer assessment exercise.

3. Context

Peer assessment has been used in tutorial groups in Economics 102 for some years (see Snowball and Sayigh (2007) for a complete account). Some of the challenges experienced with these paper-based peer assessments relate to the lack of anonymity which might have introduced bias based on friendships, gender, race or language (Li and Steckelberg 2005). The lack of anonymity also established a "pecking order" hierarchy, which impacted negatively on group cohesion and the self-esteem of some students. Inspired by a fictitious case study developed at the University of Bath on the use of Moodle's Workshop module (Parmar n.d.), we explored the potential of the online medium to address some of these challenges in small-group settings.

4. Workshop setup

Cognisant that students might find the feature-rich Workshop module overwhelming, we limited our use of the module to the basics of submission and random distribution of assignments, grading and providing feedback using an assessment grid, and making assessed work available to the authors along with any feedback that they have received from their peers. Since our primary interest in using the Workshop module was to develop student writing by 'enforcing' at least one iteration of a writing cycle, using it for formative assessment seemed to be most appropriate. Concerns around the validity of peer assessment (Bouzidi and Jaillet 2009; Cho, Schunn, and Wilson 2006) as well as the reported obscure way in which the Workshop module calculates final marks - some describe it as somewhat of a dark art – also prompted us not to use the Workshop module for summative assessment.

Setting up the Workshop module so that peer assessments were handled anonymously allowed us to overcome one of the major challenges associated with doing paper-based peer assessments mentioned above. While we acknowledged that the reliability of the peer mark could be enhanced if the essays were also assessed by the lecturer or tutors whose assessments would then be incorporated into the final mark, the formative nature of this peer assessment exercise made such tutor assessments redundant. Instead we required each submitted essay to be assessed by two peer assessors.

Although we recognise the potential of having students' assessments graded for motivating them to them to produce better quality assessments, we did not use this feature because of the obscure way in which the Workshop module calculates final marks and because the mark that students received for this formative exercise was less important than the feedback.

Given that this class of students has had previous experiences with peer assessment in tutorials, we did not publish any exemplar essays. Also, because assessing the work of others inherently promotes self-reflection (Topping 1998), we did not require students to assess their own work. Students were given limited time to respond to the feedback received from their peers before being required to submit a final version of their essays for summative assessment by tutors. In view of the fact that peer marks were not used as a component of the summative assessment, we did not require assessors and assessed to reach agreement on the feedback comments before the marks were calculated.

Although we set the "over allocation level" to one in order to ensure that all essays are assessed by at least two assessors, some students reported that they only received one feedback report. Finally, as a way of communicating high expectations (Chickering and Gamson 1987) we published a league table containing the five essays with the highest (peer) scores. We have, however, not solicited students' interest in or use of this league table.

5. Peer assessment process

In 2009 online peer assessment was introduced for the second essay of the semester. By this time the students had already experienced "off-line" peer assessment with one of the tutorial exercises and had ample time to become familiar with the course website on the LMS. We were conscious that this was the first implementation of online peer assessment at our institution and that size of the class might negatively impact on the outcome of the process. Following Gibbs (1999), we were therefore careful to provide students with a rationale for engaging in the peer assessment by making the value for their learning explicit during face-to-face class meetings, on the course site and in the News forum.

We were also meticulous in providing students with detailed information about the peer assessment process, which included advice on giving feedback using the assessment rubric as well as step-by-step instructions with screenshots for navigating the Workshop module. Forums were used for ongoing support and scaffolding, as well as for sharing of developments as they unfolded.

Since the peer assessment replaced one of the weekly tutorial exercises, the time frame for the exercise was limited to a week. By the end of the Monday (23:55) students had to submit the first versions of their essays to *Turnitin*™ and to the Workshop module. Students initially had about 58 hours to assess their peers' essays before Thursday at 10:00 at which time a hard copy of their assessment grids had to be handed in to their tutors in the place of their usual weekly tutorial exercise. Thereafter students had about three days (from Friday to Sunday) in which to respond to their peers' feedback before submitting the final version of their essays on the following Monday.

In an attempt to manage potential issues around academic integrity, we required students to submit the first version of their essays to Turnitin before they submitted it to the Workshop module as a way to "copyright" their work. Similarly, students were required to submit the final versions of their essays to Turnitin before submitting it to their tutors for summative assessment.

Due to extremely unfortunate technical problems, our installation of Moodle became unstable at the critical time when students had to submit the assessments of their peer's work resulting in the target date for the submissions of peer assessments being postponed from the Thursday to the Saturday. The lecturer then also gave students the option to do the usual weekly tutorial exercise that was published in the course handout, rather than participate in the peer assessment exercise. This led to only about half of the class of 800 students participating in the peer assessment exercise.

6. Method

An end-of-course evaluation questionnaire was developed using Rhodes University's Evaluation Assistant, a web-based tool for developing and managing teaching and course evaluations. While the evaluation questionnaire elicited student perceptions on a wide range of issues related to the whole course, three Likert scale questions and one open-ended question were aimed at eliciting student experiences of the peer

assessment exercise in particular. In order to enhance the response rate, evaluation questionnaires were administered by tutors in tutorial groups. The response rate was 64%. Likert scale responses were captured using an Optical Mark Reader while open-ended responses were captured before they were extracted and analysed using NVivo 8.0.

In addition, a representative sample of fifty essays was analysed by an experienced student tutor in order to determine the effect of the peer assessment process on the quality of the final submissions. Since this paper primarily focuses on the technical aspects of the Workshop module and student experiences of online peer assessment, these results are reported on elsewhere (Snowball and Mostert).

7. Contribution

Student responses to Likert scale statements in the end-of-course evaluation questionnaire revealed that 58% of students agreed or strongly agreed that the peer assessment exercise had helped to improve their essays (Figure 1).

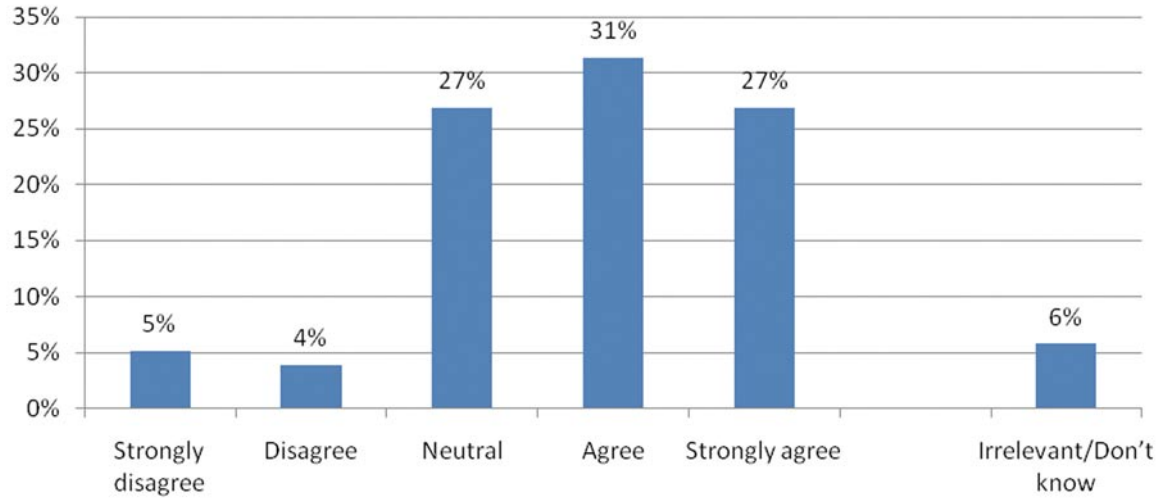

Figure 1. The peer assessment of essay 2 helped to improve the quality of my essay (n=465)

This finding is supported by responses to the open-ended question, "Setting aside the technical problems with RUconnected, did you find the peer assessment exercise for essay 2 useful? Please explain why or why not": 56% of the students responded positively ("Yes and No", "Yes, somewhat", "Yes", "Absolutely Yes", see 2).

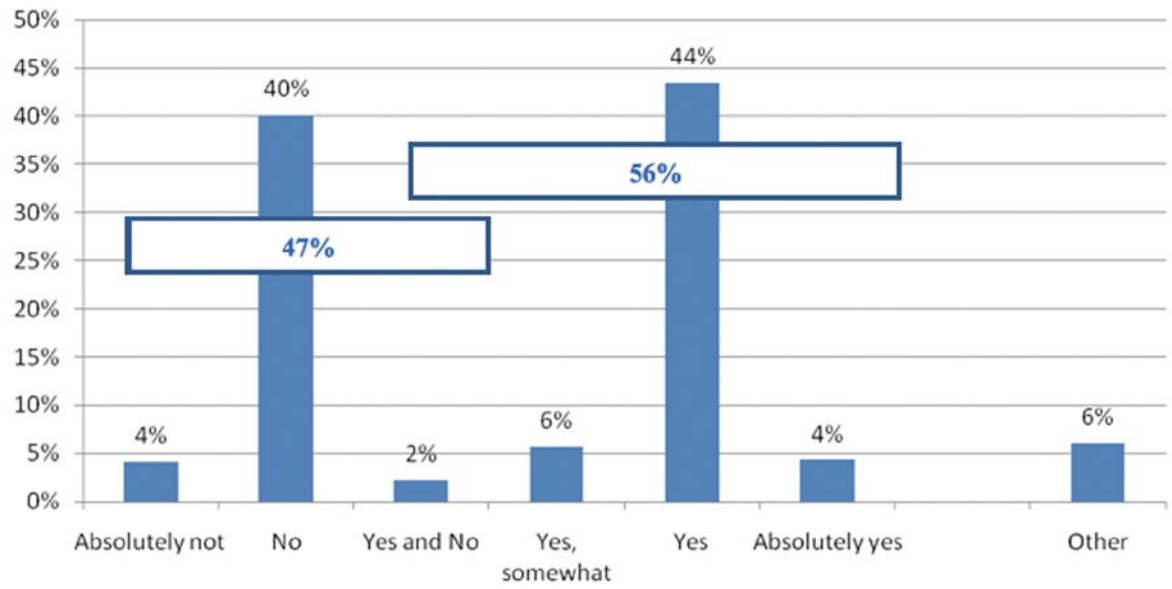

Figure 2. Did you find the peer assessment exercise for essay 2 useful? (n=563)

One student's response probably summed it up succinctly:

> *"I had not realized that I had made minor errors in my essay, but after getting my peer assessment results I was able to improve my essay. It is really useful; I would recommend to be kept for years to come."*

Reasons most often cited for finding the peer assessment activity useful include that:
it gave students a chance to improve their essays in order to obtain higher marks (27% of the positive responses) and it assisted them in identifying mistakes (19%),

> *"Yes, my assessor helped me a lot by pointing out my strengths and weaknesses, that way I didn't have to make the same mistakes in my final submission. If anything, I'd say it helped improve my essay."*

and it encouraged self-assessment and fostered a more realistic sense of the value of their work (15%);

> *"The peer assessment for me was good idea because it led me to get new ideas on how I could improve my essay writing and when marking other students' essays you tend to look at mistakes that you, yourself were making and in that way you improve as a writer."*

Students felt that they received constructive feedback from their peers (13%) and that they were exposed to other perspectives (9%),

> *"Yes, gave me someone else's perspective about how to tackle my essay in a constructive way as well as showing me how others tackled the problem."*

which enhanced their sense of the essay requirements (4%).

> *"The peer assessment in a positive way has been helpful as one was assessed and it helped for one to know what exactly was needed. As students we ended up knowing what we should have wrote."*

Forty-seven percent of the responses, on the other hand, indicated that the peer assessment exercise was not useful ("Absolutely not", "No", "Yes and No") – see Figure 2. Of these negative responses, 29% bemoaned superficial engagement or lack of engagement with the essay and/or the peer assessment process.

> *"No, no, no and no! People didn't even bother reading the essays the just commenting on what they expected to be in there. How do you explain saying I have a good diagram when there is no diagram? It's a no-no for me."*

Other reasons for not finding the peer assessment activity useful included:

a concern about the intellectual property of students' work and that lazy students can easily abuse the system to obtain high scores (26% of the negative responses);

> *"I don't think that is a good idea because not all of us are honest, someone might copy your work and submit it before you in the final submission and you get a high rate of plagiarism for me when I submit my work."*

lack of confidence in assessors and/or assessments (19%);

> *"No! Total waste of time. A blind man cannot lead another blind man to a destination. Seriously, [I] thought it was a waste of time and really now, some students don't even know what is going on with their own essays, let alone someone else's. Scrap the idea for the sake of the 1st years in 2010."*

receiving contradictory or misleading feedback (11%);

> *"Definitely not, the two people who marked mine gave two completely different views that even opposed one another which ultimately left me confused and no longer understanding the concepts which I thought I had grasped ..."*

the time-consuming nature of peer assessment and the increased workload (9%);

> *"It takes up too much of my time and a lot of effort."*

poor quality of submitted essays (4%);

> *"No, due to the fact that we were going to have time to adjust our essays after the feedback from our peers, most people didn't do their initial hand in properly and therefore defied the whole purpose."*

an overly-complicated process with too many different deadlines (4%);

> *"Not really, it was quite a long process and not everyone managed to follow it properly. I personally found it as a waste of time."*

lack of confidence in the peer assessment process or unfairness (3%);

> *"No, the exercise couldn't help me as an individual because I struggle with ecos to a large extent, so I didn't see how marking someone else's potentially A+ or F essay would help educate me. In fact, I felt that when I read some things I never knew it made me feel stupid."*

and lack of confidence to assess (2%).

> *"... I found doing the peer assessment difficult as I am unsure of everything exactly myself ..."*

Likert scale responses indicate that students seemed to value peer assessment more for the feedback that they provided (71%) than for the feedback that they received (44%) (See Figure 3).

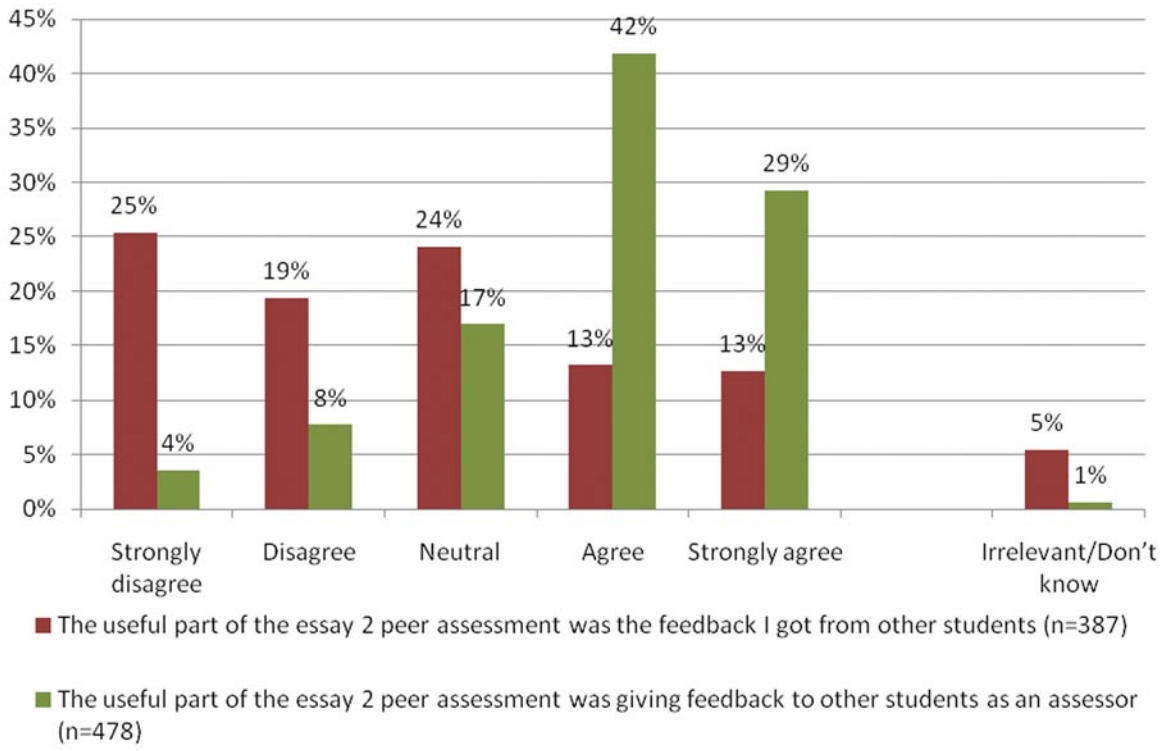

Figure 3. Likert scale responses to peer assessment questions

This notion was backed up by some of the open-ended responses:

> *"Well it was very useful; I identified a lot of things the tutors put up with, the carelessness of the students. It also motivates you to see the amount of hard work people put in their work."*

> *"It was useful because it helped me to be objective as I write my essay because I will be looking at it from the marker and writer's point of view."*

With regard to the tension between learning as collaborative and reciprocal rather than an individualistic, competitive endeavour, many students expressed concern that, while they had put much effort into providing useful feedback, no effort was put into the feedback that they received. While some students were open to the idea of helping others,

> *"Yes, it allowed one to put their knowledge to great use, helping other students whilst learning yourself ..."*

> *"... No, because not everyone approaches the assessment with the same mind frame – to help others ..."*

others were less willing to do all the hard work only for the "lazy" students to benefit from it,

> *"No, because some people had makeshift essays that were full of rubbish and I refuse to help laziness."*

In conclusion, some students expressed appreciation for being able to benefit from their peers' insights,

> *"Yes, it was very much helpful. I realized that there was more to learn from other students than them learning from me. Information was shared in an excellent manner and it taught me to learn more to be competent."*

some found peer assessment affirming,

> *"Assessing others' essays was helpful – it made me realize that other students are at my level or lower. I often felt I was the only one struggling."*

fulfilling some real needs,

> *"Yes! Sometimes you write an essay and wish you could have someone to read it and I think this should be done more often."*

and generally a good idea.

> *"Yes, but to a limited extent. Many students abused the opportunity, others did take it seriously. It was long but easy and fun to be in the mind of another student and understand how the markers feel. Be the marker was a great idea!!!"*

8. Evaluation

With regard to facilitating the process of online peer assessment, we found the Workshop module more than adequate in addressing many of the logistic challenges of paper-based peer assessment provided that the academic integrity issues introduced by the digital format of the texts are also managed.

Since our research was primarily aimed at exploring the effect of online peer assessment on the quality of student essays (on which we report elsewhere), we did not explore student experiences of using the Workshop module specifically. However, it was clear from the student responses that more students reported positive than negative experiences of the process, despite considerable technical problems experienced with our installation of Moodle at the time when students were submitting their assessments. Although the systems administrator did not directly attribute these technical difficulties to our use of the Workshop module at the time, this view has to be tested. If these technical difficulties were indeed related to our use of the Workshop module with such a large group of students, it is hoped that the redevelopment of the Workshop module for Moodle 2.0 would address this issue. Such challenges nevertheless highlight the vulnerability of technological systems and the value of having a contingency plan.

Lack of engagement with the process was apparent in the many reports from students who felt that their intensive efforts at providing feedback to their peers were not matched by the feedback that they had received from their peers. While the Workshop module provides the functionality for students' assessments of their peers' work to be graded automatically by comparing it with the "best" assessment we have not used this feature. Further research is needed to investigate the potential of this functionality for addressing this lack of engagement.

Being an English first language speaker gives a significant advantage when writing essays and essay type questions in economics. With regard to the perceived value of peer assessment for improving student learning, it would therefore be worthwhile to explore potential differences between the experiences of English mother tongue students and students with English as an additional language, especially in the light of the increasing proportion of students for whom English is a second or third language.

9. Conclusion

This paper reports on research aimed at exploring the potential of Moodle's Workshop module to support a formative peer assessment process in order to ascertain the value thereof for improving student learning.

Acknowledging that we have not used the full range of features of the Workshop module and in spite of reported issues with the module itself and unfortunate technical difficulties at the time of our use, our research provides empirical evidence that the Workshop module not only addresses some of the challenges inherent in face-to-face peer assessment, but also provides a range of additional options for enhancing validity and reliability that would simply not be manageable in face-to-face settings, particularly in large classes.

While student responses to online peer assessment were mixed, there is some evidence that some of the potential benefits of peer assessment were realised for some students at least. In particular, it seems to have been the change of 'position' from student to assessor that students found most useful in improving their work, rather than the peer feedback they received. While the potential of formative online peer assessment for improving student learning is more difficult to demonstrate, for some students at least, the process was 'eye-opening' and seems to have contributed to their sense of achievement and the quality of their work. In this context, reliability of assessments becomes of secondary concern as formative peer assessment may hold great potential, especially for English second and third language students.

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ICT's participatory potential in higher education collaborations: reality or just talk

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Recently, interest has sparked in collaboration and networking within and between universities, industry, government and the wider populace. Knowledge transfer has gradually become a strategic issue, so that many governments and funding bodies now use economic-based incentives to mandate collaboration in hope of stimulating innovation, improving efficiency and promoting inclusion. Web 2.0 has been heralded as an enabler of collaboration. Powerful new tools abound to enhance collaborative initiatives. We investigate uptake of these tools and their impact on collaboration in the Australian context. Although research is scant, the literature provided a preliminary picture of web2.0 usage patterns amongst Australian academics, researchers and professionals. Adoption of virtual collaboration tools for work activities is lower than expected. Connectivity, accessibility and availability do not seem to be major deterrents to Web 2.0 use, suggesting appropriation is the problem. It remains unclear whether these technologies have encouraged further collaboration: at present, these are primarily social devices and tools, their beneficial work applications are yet to be fully unmasked. It is argued that further research and broader professional learning opportunities would support greater Web 2.0 appropriation.

Keywords: *changing environments, changing tools, collaboration, collaboration and innovation, collaboration and change, effectiveness, efficiency, higher education policy and strategy, pervasive connectivity, policy development, policy analysis, productivity, quality, research, reduced funding, responding to change, social networking, technology, tools, uptake Web 2.0, Web 2.0 tools*

1. Introduction

Over the last decade, the notion that 'conflict costs', while 'peace pays' has taken hold. Reappraisal of competition highlighted the wastefulness of redundancies inherent in competitive set-ups (Kemmis et al. 2003; Rosen 2009) and, consequently, collaboration was elevated to a central role in the *Zeitgeist*. This reflects broader growth in openness and sharing (exemplified by Tapscott and Williams 2008), as adversarial processes, such as confrontation, competition and the ethos of 'winner takes all', proved inefficient and ineffective for solving complex challenges in today's world. These paradigm shifts began at grassroots level, enabled by coincident emergence of a host of new (and often free) Information and Communication Technology (ICT) tools that could make collaboration easier than ever before and foster creative relationships between diverse stakeholders. Higher education (HE), operating largely under public sector regulation, has not been isolated from resultant public policy developments and other external pressures that increasingly make collaboration obligatory (Leimer 2009). However, it remains unclear whether this collaboration mandate has become a reality and, indeed, whether ICT is a participatory enabler and 'holy grail'.

Due to this 'sea change', HE collaboration has grown in volume, diversity and form. Collaborative endeavours have been studied extensively, generating volumes of sound research and conventional wisdom scattered across many disciplines (e.g. Kock et al. 2001; Merle 2001; Pirani and Sitko 2008). Most work focuses on process dimensions of effective collaboration (developing, establishing, organising and managing partnerships, team dynamics, stakeholder engagement), with limited examples of leadership for linkage, information and service sharing or organisational policy development (cf. Goering 2003). Education literature mainly reports collaborative teaching, learning and research, but little on collaboration for other reasons.

Given that universities have become 'organisations', great potential exists for interdisciplinary lessons from well-established management and governance literatures on joint ventures, strategic alliances, hybrids and the like. Sufficient is known for certain "guiding principles" to be documented and developed as a framework for best practice.

Nonetheless, no attempt is made to fully review the definitions, exemplars and guides or benefits, challenges and cautions disclosed in this vast literature; although given the increasing importance of collaboration to HE sustainability, such a synopsis would be valuable and timely. This paper starts by considering what's new about this 'new-economy' collaboration, followed by a brief overview of recent changes in the HE sector internationally and similar developments in Australia. Our focus being ICT, and online collaborative tools particularly, we discuss the concurrent ICT revolution linked to the Internet and Web 2.0 technologies, suggest key ICTs having potential to foster and support collaborative initiatives, consider how ICT can aid collaboration and assess its uptake and contribution to Australian HE collaborations. We conclude by outlining future research needs in relation to ICT (including Web 2.0) for e-collaboration.

2. What is collaboration?

It is fashionable to describe any working relationship as "collaborative". Although the terms 'coordination', 'cooperation' and 'collaboration' are used interchangeably, a distinction can be teased from the literature: coordination is simply synchronizing or integrating activities for efficiency; co-operation involves individual tasks aimed at shared goals; collaboration means joint participation to meet a common goal to construct new meaning or outcomes beyond what the participants' capacity and willingness would allow them to individually accomplish (Hartono and Holsapple 2004). Collective decision-making, including about roles, responsibilities and project scope and direction, are hallmarks of true collaboration (Toepell 2001).

Some would argue that collaboration in HE has long existed. What is new is the institutionalisation of collaborative linkages and the more highly interdependent collaboration necessary in a connected, knowledge-based economy. Future collaborations will embrace multiple stakeholders in a complex network of relationships, drawing on the strength, flexibility and efficiencies that characterise web formations.

3. International context of change

Since the mid-1980s, major changes in HE have required universities to expand their activities while still striving to maintain traditional roles of research and education (Abramo, D'Angelo and Solazzi 2009):

- changes in amount and basis of funding;
- new business models to accommodate the 'new' economy, globalisation and labour market changes;
- increases in third-stream activities to counter direct funding deficits and support the more active role in regional and national socio-economic development and competitiveness now expected (Gunasekara 2006);
- changes in the student population age profile, mode of study and learning styles, and an increasing demand for client-oriented service (i.e. learner-centred education delivered 'anywhere, anytime, anyhow');
- rising numbers of students due to internationalisation and growing demand for access to lifelong learning and professional development; and
- greater accountability and reporting requirements.

Coupled with reduced availability of funding opportunities during the recent global financial crisis, these changes have produced powerful drivers pushing HE towards collaboration: increasingly interdisciplinary, complex, costly education research and delivery; declining government funding; government programs that either encourage or mandate research and teaching partnerships, collaborations with industry, engagement with communities and formation of specialist networks or centres of excellence; policy orientations towards mutual obligation and reciprocity; and funding support increasingly conditional on collaboration among universities, disciplines and across national borders (Abramo, D'Angelo, and Di Costa 2009; DeFillippi 2002; Lee and Bozeman 2005).

User-led innovation for research relevancy and political pressure to derive some funding from third-stream activities (Geuna and Muscio 2009) also encourage collaboration. Despite numerous, unresolved, thorny issues regarding funding and intellectual property, collaborative course development and delivery is increasingly common. The real art is maintaining differentiation (to meet diversity in HE demand) while being collaborative and global.

4. Australian perspectives

The Australian HE sector has been riding similar waves of change through reforms by successive governments over the past thirty years. Here, too, the emphasis recently shifted from competition to collaboration, as the same change in sentiment and governance arrived with the Rudd government (2007).

Reviews of HE (Bradley et al. 2008) and the National Innovation System (Cutler 2008) provided the foundation for long-term decisions about Australian HE for the next decade and beyond. These reports identified a range of national and regional challenges and opportunities: of direct relevance to this discussion are their recommendations for improving research collaboration and coordination for production, diffusion and application of new knowledge for innovation; maintaining national competitiveness in the globalised HE market; strengthening relationships between HE and vocational education and training; and improving the availability and use of technology for research collaboration (among other things). Other Government agenda, such as improving HE participation rates, enhancing student choice, improving alignment between HE and labour force needs and extending HE opportunity to a broader range of regional and remote communities (DEEWR 2009), will also inevitably involve collaborative processes.

Marginson (2008) identified connectivity—capacity to engage and connect sustainably across borders in different parts of the world using position and resources to best advantage—as the mantra for the future. Innovation Minister, Senator Carr (2009), confirmed improving connections between different parts of the innovation system as a priority for this Government, since Australia ranks last in the OECD for research collaboration between universities and industry. Increasing and broadening collaboration within the HE sector itself is also a priority. The Labour Government has funded programs to foster links between businesses (Enterprise Connect), between universities/graduates and businesses (Researchers in Business) and amongst universities (Australian Learning and Teaching Council's requirement for cross-institutional collaboration). Government 2.0 Taskforce was formed to promote transparency and openness of government and wider availability of public sector information, by encouraging and trialling online engagement. The government is also investing heavily in creating digital infrastructure for supporting collaborative research, rolling out the National Broadband Network (NBN) to provide greater access and the Digital Regions Initiative to bring together communities and services to realise the affordances of an NBN. Our digital research infrastructure is well-supported by Aarnet, giving researchers domestic and international connectivity, but there needs to be much greater clarity about its potential articulation with the NBN and the research and business opportunities this could provide for the Australian HE sector.

5. ICT revolution

This same period has witnessed major changes in ICT—a shift from immobile, hard-wired, desktop infrastructures to mobile, handheld and wireless modes of communication and computing, along with the rise of the Internet and Web 2.0 technologies, which together offer dynamic modes of interaction and facilitate the collection, analysis, storage and exchange of vast amounts of information. The new generation of media technologies and the success of the so-called 'Web 2.0' tools highlight the participatory potential of internet-based media platforms. Collaboration (or strategic alliance) has been a popular option for some time (e.g. Bleeke and Ernst 1993), but it has gained momentum since Internet-provided global infrastructure has made creation of large virtual communities possible, birthing a new buzzword, 'e-collaboration' (Kock 2007).

6. ICT and collaboration

Collaboration is achieved by a combination of people, processes and technology. Technology is perhaps the most tangible aspect. ICT now makes possible a variety of collaborative workspaces for project teams and networks. Web 2.0 technologies are inherently about interaction, some more specifically than others.

Synchronous modes of interaction (Table 1) that facilitate collaborative activities range from familiar methods, such as videoconferencing, analogue telephones and digital mobiles, through Voice Over IP (VOIP) services, like Skype, to text-based media, such as instant messaging services and chatrooms, and multi-media tools, like webinars and virtual workspaces. Some asynchronous services (Table 1), such as forums or multi-modal social networking utilities (Facebook, MySpace), may seem synchronous to users who are "always on" and so are referred to as semi-synchronous (Coleman & Levine 2008). There are also ample asynchronous interaction opportunities (Table 2): email, blogs, microblogs, wikis. Other sorts of collaborative Web 2.0 tools include applications for sharing documents, videos, slides or news, perhaps the most notable being the free tools, YouTube, Google Docs and Google Apps for Education. Collaborative initiatives can be served by, for example, Google Groups (forming interest groups) and Google Sites (collaborative creation of websites). Synchronous, semi-synchronous and asynchronous communications are all necessary for virtual teams (Montoya et al. 2009).

Collaboration can be supported by ad hoc integration of various ICTs or by a commercial, integrated product (Table 3). Cloud computing supports many Web 2.0 technologies, encouraging numerous free Web 2.0 versions of office suites: two examples are Mikogo (offering a large array of collaborative features, such as desktop and application sharing, remote keyboard and mouse control, meeting recording and playback, whiteboards and file exchange) and Google Wave (combining elements of email, instant messaging, wikis and photo sharing) (Devaney 2009).

Although further literature review might refine the activity list, and the tool list will no doubt quickly become outdated with new technologies probably available before this paper is published, our preliminary matrices mapping technology onto collaborative activities (Tables 1-3) show that powerful new tools abound to enhance collaborative initiatives. So, how have these tools been received and what has been their effect?

	SYNCHRONOUS									SEMI-SYNCHRONOUS	
	Telephone	Teleconferencing	Video conferencing	Voice-over IP (eg Skype)	Instant messaging (eg IOQ, MSN)	Chatrooms	Webinars	Virtual workspaces	Shared whiteboards	Online forums (eg Elluminate)	Social networking utilities (eg Facebook, MySpace)
COMMUNICATION											
Interaction that requires real time give and take	•	•	•	•	•	•		•	•	•	
Interaction that requires multiple individuals		•	•	•		•	•	•	•	•	
Interaction that requires visual social cues			•				•				
One to one communications	•			•							
Non real time communication										•	•
CONNECTION											
Share team/member directories											•
Share distribution and contact lists											•
One to one messageboard					•						
One to many messageboard					•						
Advertising/public presence							•	•		•	•
COORDINATION											
Scheduling and project management		•	•	•				•			
Progress/planning meetings		•	•	•				•	•		
Project updates		•	•	•					•		•
Task management										•	
Complex problem solving		•	•	•		•		•	•	•	
Workflow integration										•	
Addressing team effectiveness and functioning		•	•	•				•	•		
Interpersonal issues	•										
Training		•	•	•			•	•	•	•	
Presentations		•	•				•	•	•	•	
CONTENT											
Content/resource creation						•		•	•	•	
Information discovery								•			
Content access								•			
Content adaption		•	•						•		
Information storage and retrieval											•
Sharing documents or other information											•
Non real time information sharing with entire team or sub-group										•	•
Different time zone information sharing with the entire team or sub-group									•	•	
Collecting comments											
Searchable archives of contributions						•				•	
Surveys	•			•							

Table 1. Matrix mapping synchronous and semi-synchronous ICTs against collaboration activities (After Montoya et al. 2009:Table 7, 153)

	ASYNCHRONOUS																			
	Voicemail	Email	SMS/MMS	Blogs	Microblogging (eg Twitter)	Wikis	RSS feeds	Podcasts	Vidcasts	Portals	Websites	Search engines (eg Google)	Online databases/directories	Shared calenders/meeting scheduling	Document repositories/ mananegemtn systems	Document sharing (eg Google Docs, Google Apps)	News sharing (eg Digg)	Video sharing (eg YouTube, Teacher Tube)	Slidesharing (eg SlideShare.net)	Social tagging (eg Delicious)
COMMUNICATION																				
Interaction that requires real time give and take																				
Interaction that requires multiple individuals																				
Interaction that requires visual social cues									•											
One to one communications	•	•	•																	
Non real time communication	•	•	•	•	•	•		•	•											
CONNECTION																				
Share team/member directories											•		•	•	•	•				
Share distribution and contact lists		•			•	•					•		•	•	•	•			•	
One to one messageboard					•															
One to many messageboard		•		•	•	•					•									
Advertising/public presence		•		•	•	•	•	•	•	•	•	•				•	•	•		
COORDINATION											•									
Scheduling and project management	•	•	•			•								•	•					
Progress/planning meetings		•												•						
Project updates		•		•	•	•	•	•	•		•				•	•				
Task management		•				•								•	•	•				
Complex problem solving		•													•					
Workflow integration						•								•						
Addressing team effectiveness and functioning				•																
Interpersonal issues	•	•	•																•	
Training				•		•	•	•	•		•	•				•		•	•	
Presentations						•		•	•							•		•	•	
CONTENT																				
Content/resource creation					•	•					•		•			•				
Information discovery				•		•	•					•	•				•		•	•
Content access		•		•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•
Content adaption						•					•		•		•	•				
Information storage and retrieval				•		•				•	•	•	•		•	•			•	•
Sharing documents or other information		•	•	•	•	•	•	•	•	•	•		•		•	•	•	•	•	•
Non real time information sharing with entire team or sub-group		•		•		•	•	•	•		•		•		•	•				•
Different time zone information sharing with the entire team or sub-group		•	•	•	•	•	•	•	•		•		•		•	•		•	•	•
Collecting comments		•		•	•	•					•				•					
Searchable archives of contributions		•		•		•					•		•	•	•	•				
Surveys		•									•									

Table 2. Matrix mapping asynchronous ICTs against collaboration activities (After Montoya et al. 2009:Table 7, 153)

Category	Example of collaborative tools included	Commercial product examples	Free product examples
Collaborative product suites	email, group calender, threaded discussions, document management, workflow integration	Microsoft Exchange, Lotus Notes/Domino Collaborative Workspaces.com	Taskado, Techportfolio
Office suites	Desktop and application sharing, remote keyboard and mouse control, meeting recording and playback, whiteboards, file exchange, multipoint video, chat, file search, file-sharing, presentation, co-authoring	ContactOffice, eStudio, WedEx, WebOffice	Mikogo, Vmukti, Thinkfree, AROUNDMe
Collaborative portals	Instant messaging, team workplaces, people finder, e-meetings, document management	MS Sharepoint, IBM Websphere portal, Collaborative Gateway, OpenScape	CollabWiki, Collaborative Portal Server (CPS)
Desktop conferencing systems	Instant messanging/chat, audio/video conferencing, application sharing, shared whiteboard, polling voting, documenting meetings	Bored-Room, PacerForum, Central Desktop	Zimbra, Ekiga, Dimdim
Communcation suites	Email, instant messaging, wikis, photo sharing, file repositories, micro blogs, other social applications	RealizationEngine	GoogleWave, cyn.in
Web based team/project rooms	Group calender, contacts, note,s tasks, file sharing, email, chat, pinboard, project management, document management, threaded discussions, brainstorming, voting, timesheets, evaulation, scheduler	QMND, Lotus Quickr, Teamworkzone, ProjectLounge, Documentum eRoom, Workgroups 2010	Pbwiki, Socialtext, ICEcore
Electronic Meeting Systems (EMS)	Agenda, braingstorming, voting, prioritizing, action planning, surveys, shared whiteboard, meeting log, chat	GroupSystems, Meetingworks, Facilitate.com, Multics Forum	vRoom. FUZE, Meet By Web
Learning Management Systems (LMS)	Email, instant messaging, calender, threaded discussions, content storage, course administration	Blackboard, WebCT, Q2Learning	Moodle, Sakai

Table 3. Examples of integrated e-collaboration products (After Munkvold and Zigurs 2007:Table 2, 46)

7. ICT impact on collaboration

ICT is an important enabling factor, making it easier to collaborate. The major benefits of ICT, and particularly Web 2.0 technologies, are that they save money and time, support consensual decision-making, aid project management, alleviate the adverse effects of geographical distance and ease access to and interactions between experts/other stakeholders. By seamlessly linking data, knowledge and diverse stakeholders, the emerging collaborative environment is expected to stimulate innovation, increase efficiency and productivity, improve outcome quality and encourage interdisciplinary approaches and greater international collaboration.

ICT's impact on collaboration depends on the extent of its use. How HE's potential partners are engaging with Web 2.0 is also important, since technological proximity is now known to be more important for collaboration than spatial proximity or language barriers (Scherngell and Barber, 2009).

That Web 2.0 technologies are popular in the public sphere is obvious by the tidal wave of user-generated content flooding the web, but this high public usage rate probably speaks more of diffusion than anything else. Although Web 2.0 tools are often described as driving a new wave of creativity and innovation via connectivity and collaboration, in fact, only ~1% of Internet users exhibit creativity, the remaining 90% consuming or, in some cases, synthesizing, but not creating or innovating (Wang and Tadisina 2007). In most online communities, 90% of users never contribute, 9% contribute a little and 1% account for almost all contributions. According to Wikipedia's "about" page, it has only 85,000 active contributors (0.14% of its 65 million monthly visitors). Of >52,000 Facebook applications, "Causes" is the third-most popular. Although >25 million of Facebook's 200 million worldwide members have signed on as supporters of at least one cause, just 185,000 (0.7%) have ever contributed via the site (Hart and Greenwell 2009).

A literature review informed our assessment of Web 2.0 uptake in Australia. Search terms for 'collaboration' and 'research' were developed using the CSA database thesaurus, then combined to do a meta-search using the following databases: EconLit, ERIC, Health and Safety Science Abstracts, CSA Linguistics and Language Behavioural Abstracts, PILOTS Database, Psyc Articles, PsycINFO, Social Services Abstracts, Academy of Management, Sociological Abstracts. Focused searches of private and public sector repositories (e.g. GoogleScholar) were conducted, where references were initially selected by title and abstract. Computerised searches of online databases and for key references covered 1995-2009 inclusive. The resulting pool of 5,775 texts were analysed using Leximancer, refining the list to 563 references centrally-focused on collaboration for research or professional activities (excluding learning and teaching). Those mentioning ICT or Web 2.0 were manually identified and, from these, 11 reports on an Australian context were extracted.

Quantitative evidence on Web 2.0 adoption in Australia is scarce. Although not exhaustive, our preliminary literature search revealed no studies of ICT use amongst community groups or the not-for-profit sector; however, there have been some preliminary investigations of ICT use in HE and by professionals.

The technological skills, preferences and Web 2.0 usage patterns of staff have not been directly reported; however, Kennedy et al. (2008) found that, despite differences in age and exposure to technology, staff and student usage profiles differed little. Therefore, extrapolating on student surveys (e.g. Ellis and Newton 2009; Kennedy et al.2007; Oliver and Goerke 2007), it could be expected that over 50% of staff do not use Web 2.0 tools and, perhaps more concerning, across all age groups, desire to use Web 2.0 technologies such as file-sharing, webinars, blogs and wikis for study purposes will be consistently low (<50%). Although some Web 2.0 technologies (blogs, wikis, podcasts) are already used in HE, most staff use established applications of technologies, such as information searching on the web, email, mobile telephony and SMS messaging, with a smaller proportion using newer technologies that allow collaboration, production and publishing of material online, such as blogs, wikis, social networking and digital file-sharing, and even fewer using social bookmaking or creating and publishing podcasts.

Australian researchers rate online tools, databases and electronic resources (78.4%) and discipline-related literature (77%) as the most important resources for their collaborative projects (Heffernan and David 2007). However, 70% of HE collaboration in Australia is informal and probably should not be called collaboration, since it simply involves publication or a single project relationship (only 19% of researchers regularly undertake more permanent arrangements).

Hunter (2009) reports on e-collaboration by Australian universities, suggesting much broader uptake of ICTs, claiming that until recently Web 2.0 services were primarily used for personal activities or within individual project teams, but researchers are now increasingly including Web 2.0 technologies in their project proposals to enhance collaboration, facilitate document-sharing and expedite and broaden information dissemination. Hunter claims that this is accelerating the uptake of these technologies, but presents no supporting data.

Application	Preferred Tool
Sharing text Sharing presentations Sharing images **Sharing video** Sharing maps	GoogleDocs SlideShare Flickr **YouTube** GoogleMaps/GoogleEarth
Microblogging **Blogs** Wikis Podcasts	**Twitter** **Wordpress** GoogleDocs/MediaWiki iTunes
Instant messanging	GoogleTalk/MSN Messenger
Virtual worlds	Second Life
Citations Social bookmarking **Social networking** Personal portals	EndNote Delicious **Facebook** iGoogle
Calenders Notification services Password management Video/audio conferencing Web annotations Grid/Cloud computing	Outlook Calender RSS/Atom OpenID Skype Diigo Grid

Table 4. Most popular Web 2.0 tools amongst professionals (After Hunter 2009: 2)

Accelerated staff appropriation of Web 2.0 tools diverges from the student profile, since by 2008, student Web 2.0 usage patterns were exhibiting only gradual change.

This report provides a snapshot of current use and application of Web 2.0 tools (see Table 4), without revealing the proportion of academics or researchers adopting Web 2.0 tools for collaboration. Adoption patterns in the Australian HE sector are similar to in the UK. Not all Web 2.0 tools and services are used to the same extent, with Facebook, YouTube, wikis, blogs and Twitter used most frequently. Users initially choose Web 2.0 tools that are already widely adopted, free/low-cost and easy to install and use, with continuing use determined by reliability, efficacy and popularity amongst the user's peer group. This offers little commentary on whether these are the best tools for the job or just the ones with the most affordable price-tag.

In the professional sphere, as in HE, strategic organisation-wide response to Web 2.0 is still in the early adoption phase. A recent survey of 229 professionals in Australia, New Zealand and Asia (CCH 2008) found only 20.5% of organisations have planned or implemented a strategy; yet ad-hoc use (at least 25.8%) is already occurring due to accessibility and functionality of the tools. Professionals select tools based on the same criteria as researchers. Online professional communities, Wikipedia, GoogleApps and organisational social networks are the most frequently used services. Web 2.0 is used at least once a week by 59% of professionals, 43.7% using it daily for work, mostly for research or to keep up with industry developments. Nonetheless, professionals expressed little trust in the accuracy of web-sourced information lacking backing from a trusted brand or rigorous editorial process, as well as concerns about user privacy, data security and identity fraud. About half only expect Web 2.0 sources to offer relevant opinions and general reference, with 60% believing that their in-depth research and professional advice requirements are better met by premium-based sources. About 61% report that they frequently use Web 2.0 tools to collaborate with colleagues, but it is unknown which or how Web 2.0 tools are used in this regard. More traditional communication means (e.g. telephone and email) remain the most frequently used technologies.

Further research will afford better understanding of Web 2.0 use for e-collaboration in Australia. Currently, even gauging usage rates is difficult and, of course, effective use cannot be judged by mere participation. The challenge is keeping ahead of technical developments with appropriate research and identification of best practices. Emerging, integrated, browser-based collaborative tools are likely to offer greater engagement (Kennedy et al. 2006; Munkvold and Zigurs 2007), yet are not even considered in any of these studies. Nor are methods for integrating Web 2.0 tools into workflow and processes canvassed.

The paucity of directly measurable data on Web 2.0 benefits reflects lack of systematic assessment and reporting of cost-effectiveness, efficiency and productivity improvements. Many international studies assess measurable productivity gains based on citation rates (e.g. Abramo, D'Angelo, and Di Costa 2009; Lawrence 2001); but these methods have not been applied to Australian collaborations. It remains uncertain whether Web 2.0 technologies have encouraged further collaboration, inter-institutional, interdisciplinary or international. Despite availability of ICT enablers, initial investigations have not found compelling evidence for increasing internationalisation trends in scientific research collaboration (Ponds 2009). Furthermore, despite the importance of people to successful collaboration and the extensive literature on virtual teams and their dynamics (e.g. Mattessich, Murray-Close, and Monsey 2008), there has been no documentation, evaluation or discussion of communication models applied in Australian collaborative approaches. It is obvious that numerous perspectives of e-collaboration remain to be studied in an Australian context.

8. Conclusion

Based on this review, overall, in Australia, adoption of virtual collaboration tools has been lower than expected. Even under current connectivity conditions without the new NBN, access does not seem to be a problem—even in rural areas, dialup, broadband or satellite internet access is >90% (Chan and McLoughlin 2008). Since many Web 2.0 tools are free and user-friendly, availability and accessibility cannot be major deterrents to their use: that leaves appropriation as the culprit.

Significantly higher numbers of staff (Kennedy et al. 2006) and professionals (CCH 2008) use blogging, instant messaging and other Web 2.0 tools for socialising than for work/study, suggesting that these primarily social devices and tools have not yet been recognised for their beneficial work applications. More frequent use leads to greater awareness of their potential in learning and professional contexts (Kennedy et al. 2008). Not surprisingly, simply making ICTs available does not lead to use (Montoya et al. 2009). Nor is adoption of ICT a determinant of productivity, unless to save time and cut costs, collaborators focus more on technology utilization and business process redesign (Wang and Tadisina 2007).

Nearly half of professionals already use Web 2.0 tools regularly in the work-place and only 8.3% feel that Web 2.0 has no relevance to their work (CCH 2008). Usage will only continue to increase as familiarity grows, tools become more sophisticated and their potential for competitive and collaborative advantage is realised. To adequately equip our graduates for their future professional roles, HE should take the lead and provide training and use testimonials to clearly demonstrate Web 2.0 usefulness, when its use is appropriate relative to specific tasks and projects and how it can be integrated into work processes. HE traditionally favours competition over collaboration. In preparing our graduates for globalising labour markets, the central challenge is re-orienting our educational systems so as to encourage creation, collaboration, contribution and participation. We need guidelines for engaging with Web 2.0 technologies to develop a skill-set encompassing appropriate 21st-century learning and employability skills–namely, communication, collaboration, creativity, leadership and technology proficiency. Information literacy (searching, retrieving, critically evaluating and attributing information from a range of appropriate sources) represents a significant and growing deficit that needs urgent attention.

Australian researchers have barely scratched the surface of e-collaboration research. A number of authors (e.g. Jirotka et al. 2006; Munkvold and Zigurs 2007) stress the need for further research worldwide. It would be beneficial for both us and our students if we researched and developed:

- methodologies for formative evaluation of e-collaborations;
- case studies of e-collaboration projects, including failures and successes;
- evaluation of technologies and tools for supporting small and large scale collaborations across time and distance;
- better understanding of user acceptance and choice of technologies and interpersonal trust, accountability and ethics within distributed, technology-mediated communities;
- strategies, policies and tools for ownership, management and sharing of resources across virtual organisations;
- guidelines for best practice in organisational implementation and integration of emerging e-collaboration technologies into existing infrastructure and work practices;
- user training and procedural guidance for embedding ICTs; and
- demonstrator applications of Web 2.0 tools.

There are obvious, major gaps in our research, offering fertile ground for future investigation of a broad range of challenges. For the moment, e-collaboration in higher education is just so much talk, with the participatory potential of ICTs yet to be fully realised.

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Placing the student at the heart of the process: using student lifecycle relationship management and service design techniques to enhance the student experience

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The Higher Education (HE) sector is currently under increasing pressure to respond to challenges from a number of quarters. Aside from the obvious economic factors, student expectations are also changing, particularly with regard to Information and Communication Technology (ICT). So how can the HE sector meet these changing (and challenging) expectations? One approach is to focus on the small-scale efforts that can be made to improve an institution's effectiveness in enhancing the student experience.

This paper describes how using techniques traditionally associated with customer relationship management in the commercial sector can be used in conjunction with the student lifecycle to meet the changing expectations of the student. It should be considered as an early announcement of the research from several of the JISC Relationship Management Programme projects, which have been trialling service design as an approach to Student Lifecycle Relationship Management (SLRM). Examples of some of the small-scale technological changes made are also provided. This approach places the student firmly at the heart of the process and may help institutions be more flexible, efficient and effective.

Keywords: *business process, re-engineering, challenges for education, changing services, design, distance learning, early announcement, early research, efficiency, JISC, learner expectations, learner voice, mitigating risk, process streamlining, quality improvement, responding to change, social networking, service design, student lifecycle relationship management*

1. Introduction

The Higher Education (HE) sector is currently under increasing pressure to respond to challenges from a number of quarters. These include: reduced Government funding leading to a diversification of funding sources; changing demographics producing a more diverse student base; increased competition as a result of local and international challenges; and rapidly changing technologies; to name but a few. There is also an expectation that universities can adapt quickly enough to meet the changing needs of students, employers, and the community.

Student expectations regarding Information and Communication Technology (ICT) are also changing. Many students are early adopters of new technologies and expect the education sector to be equally adept in the provision and use of such technologies. This presents yet another challenge: in that whilst the rapidly changing technology base – from physical hardware (such as the iPad) to web applications (Twitter, for example) - can easily be adopted at an individual level, it becomes harder to scale this up at an institutional level. Yet there is great potential for universities to exploit these new technologies and the expertise that many students already have in this area.

So how can the HE sector meet these changing expectations? One approach is to look to the commercial sector for strategies. For example, many institutions have started to adopt Customer Relationship Management (CRM) to help manage their relationships with external customers, such as employers and enterprise agencies. As students also clearly exhibit certain customer attributes, such as paying for a service and expecting higher levels of choice, quality and experience, it therefore seems appropriate to apply commercial techniques, such as service design, to selected stages of the student lifecycle. By adopting this Student Lifecycle Relationship Management (SLRM) approach and placing the student firmly at the heart of the process, it is anticipated that the "overall quality of the student experience, the efficiency and

effectiveness of [institutions'] administrative processes and relationships [will contribute] to adding business value and delivering success" (Chambers and Paull, 2008).

This paper describes how service design techniques have been used to improve the student experience at several stages of the student lifecycle (specifically pre-enrolment, enrolment and induction). It should be considered as an early announcement of some of the research conducted by several of the projects on the JISC Relationship Management Programme (July 2009 to April 2010). The Programme consisted of two strands across HE and Further Education (FE) institutions: one focused on Business Community Engagement Customer Relationship Management (BCE CRM) and the other focused on SLRM. Whilst there are some elements of overlap between the two strands, this paper concentrates solely on the projects in the SLRM strand. Further information on the Programme is available from http://www.jisc.ac.uk/whatwedo/programmes/bce/relationshipmanagement.aspx and a full report will be published in late 2010.

2. Background

A student will come into contact with many different ICT systems during their journey through the student lifecycle – from integrated institutional software systems, such as Management Information Systems (MIS), portals, and Virtual Learning Environments (VLEs), to web-based applications, such as webmail and online registration. By identifying the interface points with these different systems and reviewing the operational processes from a student perspective, it is possible to make improvements that will benefit both the student and the institution (JISC, 2009).

2.1 The student lifecycle

The student lifecycle can be described as the institutional stages through which a student will progress on their way through tertiary education. These stages can be defined in different ways, depending on the context in which the lifecycle is being used. For example, describing fewer stages that cover larger parts of the student journey may help senior management gain a strategic overview, whilst there may be more stages with greater detail where the focus is narrower (Chambers and Paull, 2008). Figure 1 shows the main stages of the student lifecycle (note that the lifecycle may have more stages at a higher level of detail, or less at a lower level).

- Application
- Pre-registration
- Registration
- Induction
- Teaching and learning processes
- Pastoral care
- Employability and careers service
- Graduation
- Alumni processes
- Marketing

Figure 1: Example of a Student Lifecycle (Chambers and Paull, 2008)

These stages can be broken down even further. For example, Chambers and Paull (2008) have split the "Pre-registration" stage into further sub-stages (see Figure 2).

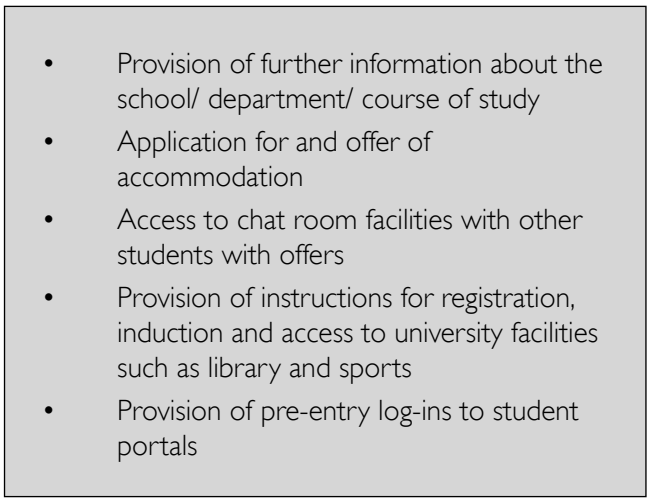

Figure 2. Pre-registration stage broken into further sub-stages (Chambers and Paull, 2008)

Using the student lifecycle as a framework may help to identify where small changes can be made at specific sub-stages. Focussing on smaller aspects of the student lifecycle ensures that an institution can be more agile in making further changes. Over time, this may have a positive, cumulative effect on the experience of both the institution and the student.

2.2 Student Lifecycle Relationship Management (SLRM)

SLRM can help improve the quality of services provided to students as well as increase the efficiency of university processes and systems. Chambers and Paull (2008) describe SLRM as: "...the development of strategies, policies, and use of ICT, to support institutions, establish, build and manage relationships with students through a range or interactions and engagements they have with them across the lifecycle of their involvement with them..."

Some aspects of SLRM have been in existence for many years, such as policies and strategies around the application, pre-enrolment and alumni relationship stages of the student lifecycle. However, the focus has mainly been on developing policies and procedures to improve the institution's administrative processes, rather than on understanding the student perspective. There is nothing wrong with this emphasis, as efficient university processes will also benefit the student. Nevertheless, making further improvements as a result of understanding the student viewpoint can have a positive impact on the institution and may even provide a competitive edge.

3. Method

The research being undertaken by the projects in the JISC Relationship Management Programme is now complete and qualitative data is in the process of being drawn out from the project case studies and reports.

Most of the projects have followed the same methodology. They each identified specific processes that could be improved at different sub-stages of the student lifecycle. The student perspective has been key, so data on student expectations and experience has been gathered via surveys (over 2000 completed responses were received across the SLRM strand), interviews, and focus groups (over 200 students across the strand). Similarly, staff members have also been approached to provide feedback. By using service design methodologies, more commonly found in the commercial sector, it has been possible to identify the 'fail points' or 'blockages', which signal where improvements need to be made. Modifications are then made

to the processes and tested via small-scale pilots designed to assess the impact of the changes made. The final stage is to obtain further feedback and make any further adjustments.

It is expected that by taking this iterative approach of gathering data, implementing change, assessing the impact, and making the necessary adjustments, both the student and the institution will benefit from an improved experience. Such small-scale agile implementations can be revisited on a regular basis and may result in the institution being able to respond more rapidly to challenges in the future.

3.1 Service design

There is little information on the use of service design methods to improve processes in education, despite some universities running modules on service design. It is also difficult to find a de facto definition of service design that is relevant to the education sector. The Copenhagen Institute of Interactive Design (2008) defines service design as: "...an emerging field focused on the creation of well thought through experiences using a combination of intangible and tangible mediums. It provides numerous benefits to the end user experience when applied to sectors such as retail, banking, transportation, and healthcare. Service design as a practice generally results in the design of systems and processes aimed at providing a holistic service to the user. This cross-disciplinary practice combines numerous skills in design, management and process engineering".

Service design is a relatively new discipline, so it is not surprising that "many senior managers involved in the service sector are still unaware of the benefits that design can bring to their offerings and, as a result, many organisations are operating at a sub-optimum level" (Hollins, 2009). This statement could also be applied to the HE sector. Hollins (2009) also cites the example of the UK eUniversities Worldwide Limited (UKeU), which failed because customer requirements were not understood. He quotes from the Select Committee on Education and Skills (UK House of Commons, 2005), which concluded: "there was no formal market research undertaken to assess either the level of demand, the nature of the demand or [critically] the type of e-learning required. There was no systematic evaluation of the markets... and no understanding of consumer demand". Would service design have saved the UKeU? Of course, it is impossible to say, but it may have helped to mitigate some of the risks.

So pragmatically, how can service design be applied in the education sector? The first step is to focus on a specific process in the student lifecycle, for example, the way in which online enrolment is handled for distance learning students. It is important to remember that one process may consist of several inter-dependent sub-processes and that changes made to one aspect may affect others. It is also necessary to conduct research into both the student and staff expectations and experience of a particular process, in order to gain a balanced view.

Various techniques can be used, including surveys, video or written diaries, focus groups or interviews, and even 'mystery shoppers'. For example, a couple of the SLRM projects asked small numbers of students (typically two or three) to act as 'mystery shoppers' and describe their experience as they went through the enrolment process. Several of the projects also began by identifying and talking to those students who had had a negative experience, working on the premise that, according to Bill Gates, "your most unhappy customers are your greatest source of learning".

Blueprinting (similar to process mapping) techniques are an integral part of service design and can be used at any stage to break down the process into its constituent stages (Hollins, 2009). This will help to identify the 'fail points' (or blockages) and 'touch points' (where the student interacts with the institution). 'Fail points' are a good indication of where improvements and changes need to be made. Blueprinting reveals the customer (or student) view of a process rather than the institutional view and provides a greater level of detail than flowcharts, for example (Baranova, 2009). Other process mapping techniques and soft systems methodologies can also be used to determine how students interact with the institution and to identify how and where improvements can be made. The process can then be redesigned. Techniques from the service industry can be adapted and implemented in the modified process. For example, some hairdressing salons use Short Message Service (SMS) to remind customers of appointments. The project at the University of Derby has been trialling the use of SMS to remind students about their system login.

It is not sufficient to simply change a process and then walk away, because 'fail points' may have been transferred from one place to another. It is also vital to assess whether the changes have actually improved the process or made it worse. This can be achieved by running a pilot, obtaining further feedback from students and staff alike and iterating through the cycle until the major difficulties have been ironed out. However, process improvement does not end there. Change is a certainty and, over time, there may be other challenges that will have an impact on a particular process. For example, there may be a change to the software used to handle online registration or students may expect to use a personal rather than institutional e-mail address. Therefore, the design and appropriateness of a process must be tested on a regular basis.

For the education sector, the service design methodology approach means that students are the core focus and that process (or service) improvement should be in response to their needs and expectations. (As a caveat, it should be noted that there may be occasional conflicts of interest between staff (or institutional) and student needs and expectations, which would then require further investigation).

3.2 The student voice

It may be considered inadvisable for an institution to assume that it knows what students want, particularly as student expectations change and universities have to evolve in order to respond to the various challenges they face. Nor is it sufficient to explore process improvement from an institution only perspective, because as most of these projects have shown, staff members do not always know what students want or expect.

Placing the student at the heart of the process and finding out about their experience and expectations may produce some surprising results. For example, one of the projects asked students how they felt about the buildings on campus. The university concerned believed that the peeling paint in some of its buildings gave it an air of 'shabby chic'. However, the students surveyed saw the peeling paint as a sign of neglect. Although this may be considered a minor detail, first impressions count and may affect the number of students who decide to take courses there.

4. Examples of interventions to improve the student experience

This section gives examples of the technological interventions made by piloting small-scale changes to targeted processes in the student lifecycle by some of the JISC SLRM projects.

4.1 Take advantage of existing skills and technologies

Many students, before they even apply to university, are experienced in ICT - from mobile 'phones to e-mail – but there are also students who are not familiar with these technologies. When students start a university course, there is a large amount of information to absorb, from coping with a new environment to understanding what is required, and studying course materials. Additionally, they are often expected to quickly master e-learning technologies, such as VLEs. Those students, who struggle to effectively manage all these demands, may lose interest and leave their course.

But what if it were possible to reduce this risk? One approach is to help prospective students become familiar with university systems at the pre-registration stage of the student lifecycle, i.e. before they enrol on a course. As well as reducing any stress associated with acquiring the necessary technical skills in the early months of study, it may also encourage students to feel part of the institution at an early stage. Conversion rates from applicant to student may improve, as well as student retention.

For example, Goldsmiths has some ad hoc arrangements in place for prospective students to talk to staff using Facebook and other social networks (Goldsmiths, University of London, 2010). However, on examining whether this approach could be made more effective, the project team discovered that the difficulty does not necessarily lie in whether a student can access such software, but in which social networking service to use. For example, whilst Facebook is well known in the UK and America (400 million users in February 2010 (Facebook, 2010)), this is not the case in other parts of the world, where Orkut (South America and India, 80-100 million (The Economic Times, 2009)) or Qzone (China, 376

million (TechCrunch, 2009)) may be more popular. Selecting a social networking site that is popular in the UK may disadvantage international students. However, one alternative, which has been considered by the Goldsmiths' project team, is to use the chat functionality of their VLE. As well as helping prospective students become familiar with the learning technologies they will encounter when they start their course, it may also ease the transition from school (or work) to HE. Such an approach can be considered a low-cost means to encourage students to engage with the institution at the pre-registration stage.

Swansea University has taken a more unusual approach to understanding the student's experience of the pre-enrolment stage of the student lifecycle. The project team has been assessing how students 'feel' about the transition from home to the University and during the enrolment process. Focusing on the emotional aspects, such as stress or anxiety, can help to identify potential 'fail points' in the process and identify areas where improvements can be made. The project team obtained feedback from surveys and focus groups and from work being done by an MA student regarding the use of social networking sites by students at the pre-registration stage (Swansea University, 2010). Prospective students already use such sites to make friends, organise events and ask questions of their peers, rather than going through more formal channels. As a result of the project at Swansea University, students unable to obtain university accommodation were encouraged to use Facebook to make contact with each other and set up house-hunting groups (personal conversation with Swansea University Project Team, 2009).

4.2 Ensure all students have access to support, advice and guidance

The diversification of the student base means that the universities must cater for those who do not fall into the category of 'traditional on-campus student'. Students can be work-based, lifelong (or part-time) or distance learners and they all need access to the support and orientation information offered to full-time on-campus students during the induction stage of the student lifecycle. They may also require additional support and expect to be able to choose the format in which they receive such information.

Distance learners, by their very nature, may feel isolated and may find it harder to develop relationships with their peers or staff. The University of East London has run several pilots to test improvements being made at the induction and orientation stages of the student lifecycle. In order to ensure parity of experience between distance and on-campus students, the University has been running a pilot to inform distance learners of the support and guidance that is available to them from Student Services, such as careers, disability, and health. On-campus students can be made aware of these services via notice boards, personal conversations, and access to support staff. For distance learners, much of this awareness raising must be done virtually, so automated welcome e-mails containing important information, such as web-links to support service information, are now being sent to recently enrolled distance learners. Various web statistics are being monitored to test the success of this approach (results not available at time of writing). However, one of the unforeseen benefits has been improvements to the institution's administrative process (University of East London, 2010).

The establishment of positive staff-student relationships is being tested by a second pilot project. Processes have been put in place to enable tutors to contact and welcome distance learners before they receive their first assessment. Prior to this pilot, the first contact a student had with a tutor was via feedback from their first assessment. If feedback was negative, this had the potential to adversely affect the staff-student relationship. When members of staff were asked about the best format for this initial contact (telephone call or e-mail), e-mail was identified as the preferred option. However, on closer analysis, it became apparent that this was based more on the perception of increased workload and time commitment rather than on the potential benefits for the student. In order to alleviate some of the fears that staff members had, policies have been put in place to assist with time management (scheduling of calls) and scripts to provide a focus and consistency during the call (University of East London, 2010). The success of this approach for the students has not yet been documented, however it is hoped that distance learners will now feel part of the institution and be confident enough to discuss problems at an early stage.

4.3 Improve the 'servicescape'

On-campus students can spend plenty of time queuing during the registration or enrolment stage of the student lifecycle. This may be unavoidable to some extent, although efforts can be made to ameliorate the process. However, students at Kingston College did not consider queuing too onerous (personal conversation with the Kingston College Project Team, 2009), perhaps because it gives them a chance to meet other students on the same course and interact socially.

If a particular aspect of the process cannot be improved, then it may be possible to make improvements to the environment (or 'servicescape') in which it takes place. The University of Derby has been examining the environments in which enrolment takes place. One of these sites is simply a corridor. Whilst queuing may be unavoidable, efforts can be made to enhance the student experience and to benefit from a captive audience. Again, borrowing from solutions used in the service sector, Derby is considering installing plasma screens in this area to provide information on the University (in a similar way to the small advertising and information screens in banks and post offices). This may benefit both the student, who receives useful information and the institution, which is able to disseminate important information in an engaging way (personal conversation with the University of Derby Project Team, 2009).

5. Evaluation

The SLRM projects in the JISC Relationship Management Programme have focussed on making small-scale changes that may have a big impact on the student experience. They have concentrated on small aspects of the student lifecycle to identify areas for improvement and applied service design techniques to home in on the actual issues. Running such small pilots that implement SLRM techniques can help to meet changing expectations, enhance the student experience and may lead to improved retention, grades and cost-effectiveness. Is it possible successfully to use commercial sector techniques and solutions in the education sector? At this stage, it is too early to tell. However, the University of Derby has found that the "blueprint has been widely recognised as a valuable tool to plot out a highly complex student experience and business process and combine this with a clear focus for enhancement effort through identifying fail and wait points". They also found that "interest in the application of service design and enhancement techniques grew exponentially at Derby as the project developed" (University of Derby, 2010).

Some of the improvements being piloted by the projects described in the preceding section have involved the use of technology outside of the institution's control and this raises issues around the social ownership of technology. Do students want to receive SMS messages from their institution or do they consider this an unsolicited intrusion? Is the use or monitoring of social networking sites by universities in order to improve the student experience considered to be an imposition on the student's digital world? (Whilst these issues are of interest, they are outside the scope of this paper).

All of the interventions mentioned above involve ICT in its broadest sense. In other words, technology is being used to improve the communication of information to students. Chambers and Paull (2008) state that the "key drivers of change in student relationship management are the changing expectations of students of their higher education experience, and the way in which they communicate with an institution". This puts the emphasis on the way in which the student communicates with the institution, but perhaps it is the way in which the institution communicates with the student that is key.

6. Conclusion

The current funding situation means that institutions need to become more cost-effective. Therefore, making the most of the systems already in place, improving processes, and ensuring that the student has a valuable experience may help achieve this goal. This aim is also in line with that of the Government, which states in the Higher Ambitions Report (UK Department for Business Innovation and Skills, 2009) that: "... students' own assessments of the service they receive at university should be central to our judgement of the success of our higher education system. Their choices and expectations should play an important part in

shaping the courses universities provide and in encouraging universities to adapt and improve their service." It also states that by being more flexible and responsive to the needs of students, the sector can "respond to the changing modes and models of higher education provision" (UK Department for Business Innovation and Skills, 2009).

Using service design techniques in conjunction with the student lifecycle to improve the student experience is very much in its infancy. It also raises many questions around the commodification of education (and ensuring that the views of staff and other stakeholders are also included), a more balanced and effective outcome may be achieved. This paper has already described examples of conflict between staff perceptions and student perceptions, but by exploring these issues further, it is possible to find solutions that benefit both parties.

The SLRM approach may help institutions be more flexible, efficient and effective, and so improve the overall quality of the student experience. Therefore, "applying the principles of Service Design [amongst other techniques] may be an effective way to examine how to improve the student experience and advance the efficiency of the related administrative processes at the same time" (JISC, 2009). Perhaps the key is simply to understand student expectations and provide agile solutions that can easily be updated to meet future challenges.

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Empirically based recommendations related to the use of virtual worlds in education

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For the past two years, final year undergraduate Computer Science students at the University of Hertfordshire have been involved in a project using the Second Life virtual environment to support their learning. The support provided included presenting textual, audio and video learning and teaching materials, delivering virtual lectures, simulations and group working areas. We have also used the virtual environment for groups of second year Computer Science learners following an interaction and games design course to develop small multi-player games based on real world game they had developed. Last year, at ALT-C 2009 the author presented a study related to the affordance of the Second Life system for group working and for delivering lectures. In the paper presented here a fuller account of this work is described. One aspect of this research has been an evaluation of the Second Life system by learners and teachers, including a comparison with other systems, such as the MLE, two dimensional virtual environments and the real world. Findings from this research are presented and a set of recommendations for the use of three dimensional virtual worlds in education is discussed.

Keywords: *learning platforms, VLEs, immersive learning*

1. Introduction

In recent years, advances in technology and lower hardware prices have made it possible for three-dimensional (3D) virtual environments (VEs) and particularly computer desktop VEs to become popular (Li & Ting 2000, Mills & Noyes 1999), and be used for commercial, social and educational applications. These technologies and their applications are used in a variety of areas such as entertainment, engineering, architecture, medicine and science. A fairly recent development has been the use of the Second Life virtual environment (http://secondlife.com/) in education and training. Since its establishment in 2003, many hundreds of organisations have become involved in setting up educational and training applications using this system. For example, the University of Hertfordshire has established an online campus within the department of Computer Science which is currently being used in order to support the learning of campus based students. In consideration of the investment necessary in terms of development cost and staff time to set up and manage these systems, it will be important to provide pedagogical justification for the use of such systems. It will also be important to consider the potential risks inherent in such initiatives.

We live and use our senses in a 3D real world environment and are adjusted to interact effectively in one. It has therefore been claimed that, 3D interfaces and VEs which enable 3D interaction provide a more natural manner of interaction with computer applications (Crossley et al., 1997). Whilst VEs, non-immersive virtual environments (NIVEs) and 3D graphical users interfaces (3D GUIs) such as Second Life are becoming more widespread and have many application areas, they contain problematic design and human factor issues that have to be addressed (e.g. Mills & Noyes ,1999; Stanney et al., 1998). In particular, navigation in 3D GUIs and NIVEs is one of the most important factors directly affecting task performance in these environments.

It seems clear that there is a strong rationale for the increased use of virtual systems in education and training (deFreitas, 2006; 2008). There has been a significant amount of research into the affordances of three dimensional virtual worlds in this area. For example, deFreitas (2006; 2008) emphasizes the importance of learning through engagement and empowering factors such as learner control within three dimensional virtual worlds. In the study reported here it was decided to investigate issues related to the factors that facilitate or hinder T&L in virtual worlds and to put forward empirically based practical recommendations which it is hoped will contribute to the existing body of knowledge in this area.

2 Group working in Second Life

An important component of software development is the requirement to work in teams. Team working has always proven difficult in software development, not least due to difficulty in arranging face to face meetings. In the past we have tried video conferencing and text chat with some limited success in managing team meetings. The following example is taken from the final year Computer Science B.Sc. module where learners of differing abilities were required to work together in small groups to solve real-life problems related to the design and production of a complex software application.

The project involved four learners working in groups. The intended learning outcomes for the project were as follows:

Knowledge and understanding of:

- a range of theoretical issues in Human Computer Interaction, including, at a suitable level, relevant research activity;
- the complexities of designing large scale multimedia and interactive systems involving a wide range of physical and human resources, including the roles of stakeholders in relation to the technical and other information necessary for the system design task.

To be able to:

- develop an advanced multimedia computer system in response to a brief setting the requirements in a real context, choosing among and deploying a range of tools and techniques appropriate to the task;
- Work as part of a team in the development of design specification documents for a multimedia system which will reflect the interests of all stakeholders in the system.

In order to support this, the following support system was established in Second Life.

- Induction sessions.
- A secure area for group working and studying.
- Note taking and recording facilities were provided.

Figure 1 shows a group meeting in Second Life. Student avatars are posing for the screen shot. Normally groups of four would sit around the table in a more natural pose.

Figure 1. Group meeting taking place in Second Life

Online resources within study areas in Second Life were provided so that all course materials were available. These included:

- Lecture notes
- Audio files of lectures
- PowerPoint presentations

Support systems used included face to face lectures, the MLE and Second Life. Lectures were provided in several formats:

- Asynchronous, where learners could view a recording of the lecture at any time.
- Synchronous lectures took place in real-time. Learners could choose whether to attend the lecture in a lecture theatre at the university, or attend a virtual presentation.
- Avatar based lectures where the lecturer was present in the Second Life environment as an avatar. PowerPoint slides were projected onto a virtual screen and the lecturer used the voice function in Second Life to communicate to the students.
- Video-based lectures took place in a lecture theatre and were streamed to Second Life. The video was presented on a screen where students could view. Learners could choose whether to attend the real-life or virtual presentation.

Below are some examples of the environment provided:

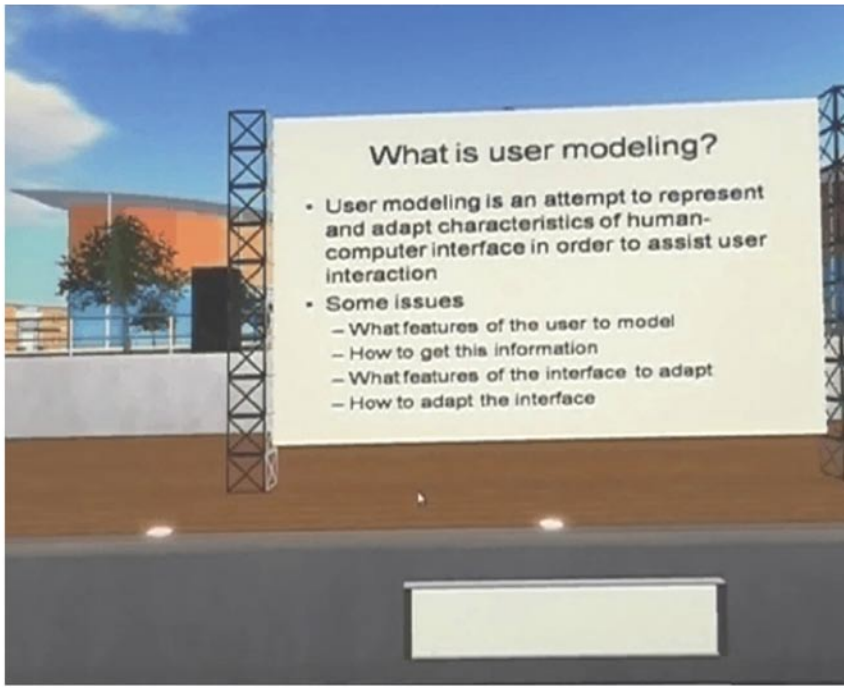

Figure 2. Asynchronous lecture in Second Life

Asynchronous lectures were delivered by the lecturer from an office within the University as shown in Figure 2. Students were able to access the recorded voice, slides and supporting materials and replay the lecture at any time.

Figure 3. Lecture taking place in a lecture room and Second Life simultaneously

Figure 3 shows the lecturer delivering a lecture live in a lecture theatre with students present. At the same time learners are in the Second Life lecture theatre seeing the lecture delivered by an avatar and hearing the voice of the lecturer. Slides presented in the real world are presented synchronously in Second Life.

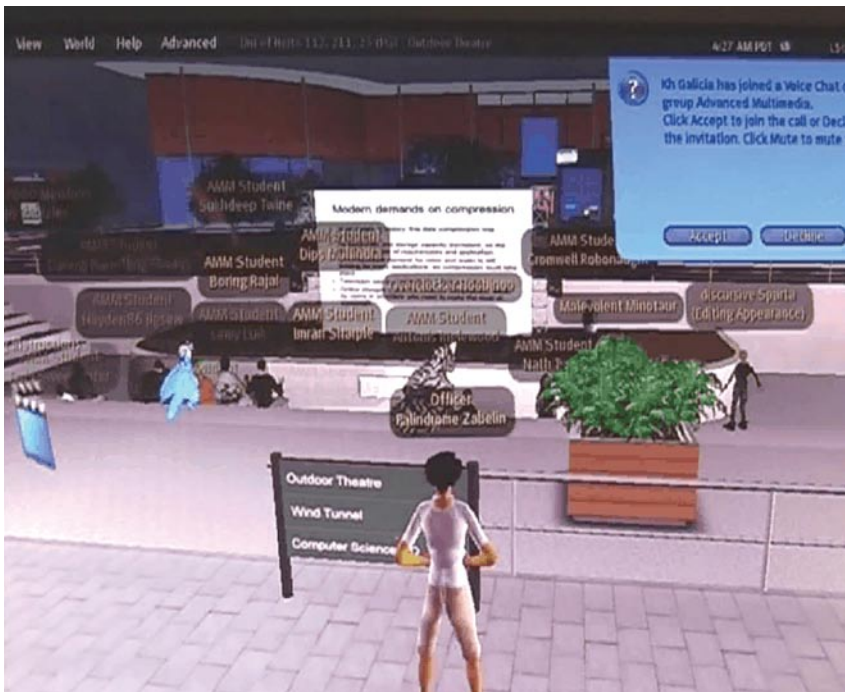

Figure 4. Lecture taking place in Second Life, delivered by an avatar.

Figure 4 presents a view of the synchronous lecture shown in figure 3 as seen by the learners present in the Second Life environment. This lecture had approximately 30 learners present in the real world lecture room and 25 in Second Life.

3. Data collection

Learners followed the module in the normal way, undertaking their project work and related studies using a combination of support systems, the MLE including group discussion areas and e-mail, face to face meetings and lectures and the Second Life environment as shown above. In order to measure and compare the affordances of these systems in supporting studies and group working a range of data collection methods were employed.

Individual and group reflective reports were collected as part of the assessment for the module. Learners were required to assess their individual and group performances and how well they were supported in their group work by the systems provided. This included a ranking exercise for common functions undertaken in their projects on these systems and a heuristic assessment of the systems. This provided a wealth of data, especially as final year computer science students are trained in the evaluation of such systems. Learners also produced an audio recording of a focus group session where they discussed the affordances of Second Life as a support system for their project work. Screen capture and data logging was undertaken so that group interactions in Second Life could be monitored. It was possible to record the duration of meetings, the interactions and communications between participants and what was discussed. In this way it would be possible to make comparisons with the records of face to face meetings undertaken by the group. Questionnaires were developed to measure learners' attitudes to the support systems provided. These were useful in conjunction with focus group sessions in obtaining qualitative data. The results of group projects were also collated in order to assess the quality of the product as well as the process. In this way, direct comparison with the work of previous cohorts could be measured.

4. Results

In this paper the analysis of reflective reports is reported only, due to space considerations. After the project was handed in, reports were graded by the module delivery team. Once grades had been awarded, reports were analysed in order to understand students' perceptions of the affordances of the environments they used. Learners were required to compare aspects of the environments provided by ranking them in order of preference (1 to 6 where 1 is best). The following table shows the rankings of the functions and features made by adding up the rankings of individual learner for various functions undertaken.

Function	Second Life	Elluminate	MLE	Face to face	Electronic mail	Phone / Skype
Lectures	2	3	4	1	n/a	n/a
Group Meetings	1	n/a	3	2	n/a	4
Communication	3*	n/a	5	2	1	3*
Social Interaction	1	5	3	2	n/a	4
Discussion	4	n/a	1	2	3	5
Resources (viewing)	2	4	1	n/a	3	n/a
Resources (sharing)	5	4	1	3	2	n/a
Immersion	1	3	4	2	n/a	n/a
Enjoyment	1	4	3	2	5	6
Ease of use	2	3	1	4	5	6
Convenience	4	6	2*	5	1	2*

* tied

Table 1. Ranking of virtual and real world features and functions (n=83)

Reflective comments in the reports were particularly interesting. For example, one student commented on the relative convenience of the systems available.

> *"Second Life was handy especially when it was the holidays. Because I live in Cardiff and the other group members live in Enfield, Second Life made it possible for us to still be able to have meetings during the holidays." (Student23)*

Although most people preferred face to face lectures, some features of the virtual systems were valued consistently highly.

> *"When considering virtual lectures I think that Elluminate was the best learning environment. After logging into system, users were able to follow the lecture step by step. The lecturer was also able to stop users from being able to speak, which was useful when other users were being immature and messing about. In Second Life, when going through the lecture I was able to follow it as if I was actually there. I was able to listen to everything that the lecturer was saying and was able to follow the slides as he went through them." (Student11)*

Communication was important to learners as the following example shows.

> *"Second life was great for communication. When a meeting was arranged all group members were able to meet and discuss issues with the project. Second life gave a realistic aspect to having an actual face to face meeting. Because each group member had a virtual person walking around, it made the meeting seem realistic. Group members were also able to press a record button and record them talking, which would them be displayed to the other group members so they were able to hear a group members voice. This was useful because group members were able to hear tone and listen to another group member's voice when communicating."*

The need for a range of tools came through quite clearly from the reflective reports

> *"I think that having the three virtual learning environments helped greatly towards the learning of this module. It made it easy to store documents, and to communicate to others. I also enjoyed the fact that I could listen and watch lectures in the comfort of my own home." (Student16)*
>
> *"I think that Studynet (the MLE) provided a great resource to be able to store files and communicate with other group members, and this is why I think this was my personal favourite. When it came to watching lectures, I preferred Second Life. I only prefer it to Elluminate because it's more fun to use. Being able to create your own little character and being able to walk around makes the whole situation seem more real and fun." (Student62)*

Comparison between virtual spaces for the delivery of lectures was interesting as the following example shows.

> *"I think that when comparing SL lectures to face to face ones, there isn't much difference. I personally preferred the virtual lectures because it meant I could work from home, and not have the annoyance of other students talking through lectures. I think that the only negative side of a SL lecture is that you can't really put your hand up and ask questions. However you are still able to communicate with the lecturer over the virtual learning environment, but he/she my not understand the point you are trying to get across as easily as they would when you were asking face to face." (Student72)*

5. Discussion and recommendations

The use of Second Life in teaching and learning is an important issue for several reasons. As computers and networks increase in capacity it is highly likely that online three dimensional virtual environments will become increasingly common. There has already been a great deal of interest in their use in teaching and learning and it is likely that as their quality improves, there will be greater demand for their use (Lorica et al., 2008).

At present the quality of the graphics in Second Life is moderate. As network bandwidth and processing power increase this will undoubtedly improve. Simulation in Second Life is also limited at present by the quality of the physics engine which provides only a limited amount of realism and limited ability to perform

calculations. Physical interaction such as picking up and passing objects is currently similarly limited. Second Life has the major benefits of being widely available and inexpensive (though true cost including the cost of development may be high). Second Life is the first generation of three dimensional virtual environments widely used in teaching and learning and it has provided us with an opportunity to look at the benefits and limitations of such systems and also to consider how such systems might be better developed in the future.

5.1 Lectures

Lecturing in Second Life was a rather strange experience. At times I felt immersed in the virtual world only to realise that I was in fact standing in a lecture theatre and that there were students in both places. It was hard to maintain a presence in two places at the same time. My personal reflection of presenting lectures in Second Life was that the teacher has less control than in face to face lecture and that this can be a problem. It is difficult to know identity of students in the lecture due to Second Life's insistence on anonymity of its users. Despite some claims that anonymity is an advantage to learners (Hollins and Robbins, 2008), it was considered to be a major limitation during the lecture. It was also difficult for learners to recognise the tutor, which led to some confusion when interacting in the environment outside of lectures. My conclusion was that Second Life is perhaps not the best way to deliver lectures to large groups of learners in its current format.

5.2 Anonymity

The problems of anonymous learners during lectures and group working was an issue which as of considerable importance. In Second Life all users have anonymous identities as dictated by the requirements of the system. An important feature of leaning relates to personal growth and the development of a personal identity. Interaction with others is vitally important in this process. Future virtual worlds used in teaching and learning should permit the use of real identities. This will make interaction simpler and more realistic and also provide additional motivation and a sense of true ownership (Jones, 2005).

5.3 Feedback and interaction

Feedback to and interaction with and from learners during lectures was slow. This was a major limitation and difference from the lecture theatre. Students reported that they felt inhibited in asking questions and that the rather slow text chat available in the environment was limiting. It was not possible to use voice chat as this proved to be disruptive in all but the smallest of sessions. Two dimensional virtual environments such as Eluminate handle text chat in a more organised way and future virtual environments used in teaching and learning would benefit from systems such as this.

5.4 Immersion

Not all students were immersed in lectures though they felt more immersed during activities. Many students reported that they preferred face to face lectures for this reason. They felt that they were less involved in the virtual lectures than in the real world ones.

5.5 Group working

Group meetings were very positive and valued by learners. Flexibility of access was valued by learners and consistently reported as a positive feature. An analysis of network graphs suggests that learners interact in similar ways as face to face meetings. It is important to understand the affordances of the environment as well as the limitations. Group working came through as one major benefit. In order to improve group working it would be useful to provide integrated note-taking and voice recording facilities for learners. The use of the history feature and non-integrated voice recorders was useful, but in general, not used well by learners. Group working was much more successful. Learners engaged well in the group activities and although they in general preferred face to face meetings, Second Life scored well in terms of online access. It was considered to be better than the asynchronous group areas of the MLE and better than contacting via electronic mail, Skype and phones. Evidence from studies of interaction diagrams of the group work

showed that learners were able to engage in group working within the virtual world much in the same way as in face to face meetings. Student feedback supported this view. It was important to establish ground rules for group working and to make sure that these were adhered to, just as in real world group work.

5.6 The environment

A major factor related to the virtual world would be the provision of better graphics and more realistic simulation as discussed above. The use of improved realistic personal avatars and with personal identities that closely resemble those of the learners would be valuable in increasing immersion and motivation (Whitton, 2009). The idea that 'my avatar is me' did not come across at all in this study. This could be achieved fairly easily in future virtual worlds.

5.7 Tasks

The tasks that we set learners to do in virtual worlds are vitally important. If learning in a virtual world is to be generally applicable to the real world, then tasks should be realistic and related to real world problems. The ability to apply what is learnt in the virtual environment to the real world is important. It is also important that real world skills are used in undertaking tasks in virtual worlds. In this way tasks are not only realistic and useful, but they are motivational and fulfilling. The setting up of work is also important. Rather than allow the virtual environment to add the excitement and motivation to learning, this might be achieved in the real world. The use of realistic and motivational tasks should maximise the sense of immersion in the virtual world. True immersion relates more to what is going on in the mind of the learner than simply to the environment. Farley states that "The successful cultivation of immersion is characterised by the learner's impression of actually 'being there' in the virtual world and is a necessary condition for presence". Farley's finding is supported fully by the analysis of the reflective logs in this study (Farley, 2009). Over half of learners in the study reported that Second Life supported group tasks well and that this led to the sense of engagement with the world (deFreitas, 2008:p6).which it is argued leads to an increased sense of immersion and motivation.

5.8 Teachers

How can we get teachers to use Second Life in their normal teaching? For it to be used generally it should be useful, simple to use and to set up and be robust. It must never let the teacher down in front of students, and should have proven pedagogical benefit. It would also be important to provide training for teachers. At present using the Second Life environment requires a great deal of technical support and also personal effort from the teacher. If it is to be used generally in every-day teaching and learning several improvements must be made. Teachers should be able to post multimedia resources to the environment and set up the environment and rooms in ways dictated by the needs of the students, for example lecture rooms and furniture. It should be possible to do this quickly as needs direct. It should be possible to assign groups of students to different views of the virtual world, allocating them to areas based on the tasks they are performing. At present these things can only be done with a great deal of input from technical support and in many cases without sufficient reliability. In summary, teachers will need to have freedom in how the world is set up and used without the need to contact technical support to undertake even the most basic of tasks. Virtual worlds might be seen as one tool that teachers can use just in the same way that we can use wide a range of online resources today. This will happen only if it is flexible, simple and reliable.

If virtual worlds are to be used in every-day teaching and learning, as we believe they will soon so be, issues such as those outlined above will need to be tackled. In addition there are issues of accessibility. There are enormous problems with accessibility and the possible exclusion of learners in Second Life. It is not yet clear exactly which stakeholders if any are likely to be disadvantaged by the system including teachers, students, technical staff, administrators and university managers. Not only are staff and students with disabilities likely to have accessibility and usability problems, but also there will be teachers and learners who will be subjected to additional cognitive load and this might interfere with their work and studies. This problem must be solved before it is used generally.

6. Summary

In this research we have used virtual worlds for general teaching with hundreds of learners. In this way we have tried not only to expose the limitations of the system, but to suggest solutions to the problems. There are likely to be many benefits of teaching and learning in virtual worlds in the future. The high development cost of creating your own virtual world and the loss of true 'social networking' in university developed systems may be too high at present for many organisations. Despite much recent research, there are few good examples of the pedagogical benefits of Web 2.0 in education. Most examples stress the motivational benefits of such systems with little regard to the true cost, the risks, or the actual benefits to learners. It is also important to understand the part that context plays in learning. Distance learners, for example already have significant overhead on their learning. It will be important to ensure that learning in a wide range of contexts and personal situations is not made more difficult by the use of difficult environments with little pedagogical benefit. Our future research will centre on finding the pedagogical benefits of such systems and also on the best sorts of assistive measures to provide for learners to ensure a successful and motivational learning experience. We hope the research presented here will go some way to suggest how this important work can be taken forward.

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Software to support student team project working: evaluating a prototype

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In this paper a prototype software system to help students to get started on their team project work is evaluated. Using a case study approach, and several cycles of the prototype, it was tested on students undertaking team projects in the information systems discipline. Students experience several difficulties that often prevent them from achieving the best outcomes from their projects, and from acquiring the desired team working and IT skills. This system was designed to supplement the existing support tools of groupware or virtual learning environments, by providing support for the maintenance roles of team working. Findings from the study showed that the students did find the system useful, and they envisaged that it would be useful for students working mainly online. The students provided suggestions for ways in which the system could be improved, and its functions enhanced. It is proposed that the system would provide an add-on for existing tools for supporting teams.

Keywords: *changing environments, changing tools, employer expectations, globalisation, learner expectations, case study collaboration, learner acceptance, support, technology, tools, VLEs*

1. Introduction

One of the outcomes from an undergraduate education is accomplishment at a variety of skill areas, including IT skills and team working skills (Dacre-Pool and Sewell 2007). The expectations of employers for graduate skills is changing, and they are looking for 'employable' graduates, who will be an investment for the long term benefit of the organisation (Hordyk 2007). The traditional IT and team working skills gained through face to face working are changing to globally aware skills, said to be essential for the changing working environment.

Team projects are a suitable learning activity for developing team working skills and IT skills in students. When students are working on campus, they are able to communicate regularly on a face to face basis, and complete their projects. However, even though studying at a university, the expectations of many students have changed, and with their other commitments, they now choose to complete more of the work for their studies at home or at some other location. At the other extreme are students who are studying completely online and do not have the luxury of being able to meet up with peers for elements of collaborative working. Learning technology plays a part in supporting all of these types of student, by providing virtual learning environments, together with facilities for email, discussion, video conferencing and document sharing to help them with their learning and team working. There is a need for research into the best tools for helping student learning and for helping to acquire IT and team working skills.

In this paper a prototype system to help students to get started on their team projects is presented, and with the aid of a case study, students' perceptions of the usefulness of the system are evaluated. The purpose of the research included to find out more about how the student teams used the output from the prototype system to help the team to get started on their projects, and establish whether the system had any impact upon the maintenance roles of team project working.

2. Literature

This section presents a review of the literature related to organisational team working skills, using team projects as a learning activity to promote these skills and the types of support used for supporting student teams.

Collaboration between employees is an integral part of the working environment, and has become the predominant pattern for organisational structures. Yen et al. (1999) suggest that collaborating engages collective wisdom and knowledge. This powerful paradigm has resulted in the word 'team' being hijacked as a 'buzzword' for modern organisational structuring, e.g. the use of 'team building' in whole departments, to motivate employees and encourage conformance to a corporate identity (Ezzamel and Willmott 2001). This has become more widespread, because it appears to give autonomy to the workforce, but at the same time it gives control to management, particularly through the technology used in the working environment (Sewell 1998). The definition of a team in this research is a small group of between 3 and 15 individuals working together to achieve a common set of goals, with shared objectives, and each team member considering how best to contribute, and often imprinting their personal identity in the social setting of the team. An idealised definition is as follows:

> *"A team is a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves as and are seen by others as an intact social entity embedded in one or more larger social systems, and who manage their relationship across organisational boundaries" (Cohen 1997, as cited in Powell et al. 2006).*

In organisations, teams of individuals with specialist skills work together to produce outcomes, that would not be possible from individuals working alone, see for example team working in the medical domain (Opie 2000), or in software development (He et al. 2007). Jewels and Albon (2007) refer to the taxonomy of team achievements, which range from 'Working groups', where interaction is predominately to exchange information, to 'High performance teams', where team members are highly committed to each others' needs and aspirations. So there is a continuum from group working to true team working, and student teams may be observed to be working at any of these levels as they progress through their team projects.

Most of the literature agrees on a division of team processes into task and maintenance roles (Beranek ae al. 2005), and the interdependence of these roles (Belbin 2000), and the literature suggests that having a common purpose and equitable division of tasks play a part in successfully achieving the task roles of a team project. The maintenance roles are affected by individuals' expectations of behaviour, how members adapt to the social situation of their work, methods of communication and how conflict within the team is managed.

Literature that is often quoted suggests that when individuals develop as a team, they pass through the stages of forming, storming, norming and performing (adjourning added later) (Tuckman 1965). It is the ways in which team members pass through these stages that determines the degree of success for a team project. At the forming stage of a project, there is emphasis on developing positive 'group dynamics', through trust building and developing team cohesion, to help the team through the storming stage (Golembiewski and McConkie 1975). The need for good communication, to deal with norms and expectations is emphasised (Hartley 1997).

In the context of the information systems or computing disciplines in higher education, team working encompasses various practical skills, such as programming, design, analysis and project management, as well as softer skills such as people management, negotiation, listening and communication. Collaborating with peers is an important form of learning, ranging from discussion of a topic to problem-based learning, many of which occur in team projects. The team project is an opportunity to learn from mistakes, and develop collective and individual skills. Literature talks about team working skills, but does not specify what sorts of skills, or how they can be acquired (Edwards 2005).

Providing the opportunity to gain experience of team working, and practice these skills is the primary purpose of student team project working. Hyland and Johnson (1998) argue that these latter skills are context specific and so cannot be taught as generalised or transferable skills, and agree that opportunities or experiences are the best way to help learners to acquire abilities to act in an acceptable and effective manner towards others in a range of circumstances.

Students working in teams have conflicting needs from the three intertwined areas of team, individual and task. On the one hand they want to work as a team, to achieve the goals of their team project, but

their primary goal is to ensure that their individual progress and grades are optimum, and this is the cause of many of the difficulties of student team working cited in the literature. Undergraduate team projects are very complex, and many students have reported difficulties in team working, resulting in negative experiences of the learning activity, e.g. (Chiasson and Dexter 2001). Kaldis et al. (2007) categorise the main problems as inadequate communication and inconsistencies, those associated with a lack of a clear structure and the resulting inequality of contribution and personality clashes.

Various tools using technology are available to help with aspects of team working, such as project management, file sharing and communication and groupware (Attaran and Attaran 2002). Co-located students are being encouraged to use these tools for their projects, in preparation for using the technology at work. However, the literature suggests that they are more useful for supporting the task roles of a project than helping students come to a shared understanding of each other, resulting from the maintenance roles; thus they do not necessarily help with many of the team working difficulties, and may even exacerbate them (Ford and Morice 2003). Experience of using online team working support tools may benefit co-located students as well as online students, as preparation for the global workplace (Hurst and Thomas 2004).

Technology tools range from communication tools, such as email, discussion forums and file exchange, to groupware designed to simplify the sharing of information within teams. Groupware systems have developed from the Group Decision Support Systems (GDSS) of the 1980's, also known as Group Support Systems (GSS), (Aiken et al. 1991). These typically involve combining computer mediated communication tools in various configurations, with client-server database networks, within a standardised interface (Khoshafian and Buckiewicz 1995); (Corbitt and Martz 2003). Groupware may include asynchronous communication tools, such as email and file exchange, but also synchronous tools, such as video conferencing or telephony.

Groupware and knowledge management systems support CSCW activities (Computer Supported Co-operative Working). But groupware was designed to help 'goal directed group work' (Jessup and Valacich 1993), with the main emphasis on enriching meetings on team projects. Corbitt and Martz (2003) go on to say that task processes are supported by such technology, but they question whether the more social aspects are similarly supported, e.g. developing trust and openness. Other evaluation studies on groupware products suggest a limited capability of these systems to support the collaborative activities, necessary for team working processes, such as discussing preferences, e.g. (Stewart 1998); (Attaran and Attaran 2002); (Salo and Kakola 2005).

It has been observed that providing a variety of communication means, for team members to choose from according to purpose, helps to generate a sense of community within online teams, and perhaps also for co-located teams (Chapman et al. 2005). Laurillard (1993) suggests that many technologies, such as audio, video and computer conferencing, only support discussion between students rather than true collaboration, and further suggests that CSCW (Computer Supported Collaborative Working) is better at supporting descriptions, providing feedback and reflection.

Virtual Learning Environments (VLEs) have a range of definitions, from web sites that include simple static pages of course material etc., to more elaborate offerings, including multimedia, 3D images etc. However, the most accepted definition refers to commercial learning support environments, such as Blackboard and WebCT. The design of VLEs comes from groupware products, providing learners with access to databases, file exchange, calendaring, as well as education specific functions such as submission of assignments and grading. Research into computer supported collaborative learning (CSCL), is concerned with investigating learning through collaboration, supported by technology. Meier et al. (2007) suggest that researchers in CSCL should be asking about the aspects of collaboration processes that promote successful collaboration, and how these aspects can be observed to add to knowledge of collaborative learning. The metaphor of the classroom, currently used as a representation of the tools within virtual learning environments, may not provide an adequate simulation of team working within the working environment. Hugo Fuks (2000) describes a groupware based support environment called AulaNet, intended to give a more realistic simulation of using groupware for learners, as it is based on a business metaphor rather than a classroom metaphor.

In the context of co-located team project working, different communication media will have their application, depending on the circumstances and the purpose of the communication (Detienne 2006). Some communication tools may be more appropriate at different stages of the project team processes than others, or more appropriate for transmitting task or maintenance parts. Often the difficulty is knowing under which circumstances particular tools are most appropriate, and students need experience to enable them to choose the tools to use in their project work (Dalsgaard 2006).

This research is concerned with establishing whether software support designed to help students to get started on their team projects, helps with the maintenance roles associated with successful team working, and so promotes the acquisition of team working skills. A prototype of a software tool to support student team project working was developed, which included the functions of suggesting an allocation of project tasks to suitably qualified team members, and providing a list of agreed ground rules for the team to consider as they start their project work.

The next section describes the methods used for this research, and how the trial of the prototype system was carried out.

3. Methods used for this research and prototype trial

This research was aimed at examining the ways in which students in a team used a new software support tool, and the impact it had upon the process of their team projects, in supporting the maintenance roles of team working. The research takes the form of an exploratory case study (Bonoma 1985), using the trial of a prototype system as the case to be studied. An interpretive research approach was taken, because we were interested in exploring the potential of this technology for helping support the learning of individuals in teams, rather than simply a positivist approach of establishing the success of the intervention of this case.

A prototype system was developed to help students to get started on their team projects, by suggesting task allocations and ground rules for the team to consider. The system did this by asking each student for their preferences and ability levels for selected key task areas of their projects, chosen by the team project tutor, and their preferences for ground rules they thought the team should adopt. The tool applies a set of rules to the data gathered and produces as an output a set of suggestions for task allocations, training and ground rules. Students in the team were able to use the output from the system as a basis for making decisions on allocating the tasks of the project, and agreeing ground rules for the team to work with. The system was written in PHP with a MySQL database, and a link to the interface was provided within the VLE area for the Team Project module. A typical interface for a team member to select their preferences and ability levels is shown in Figure 1.

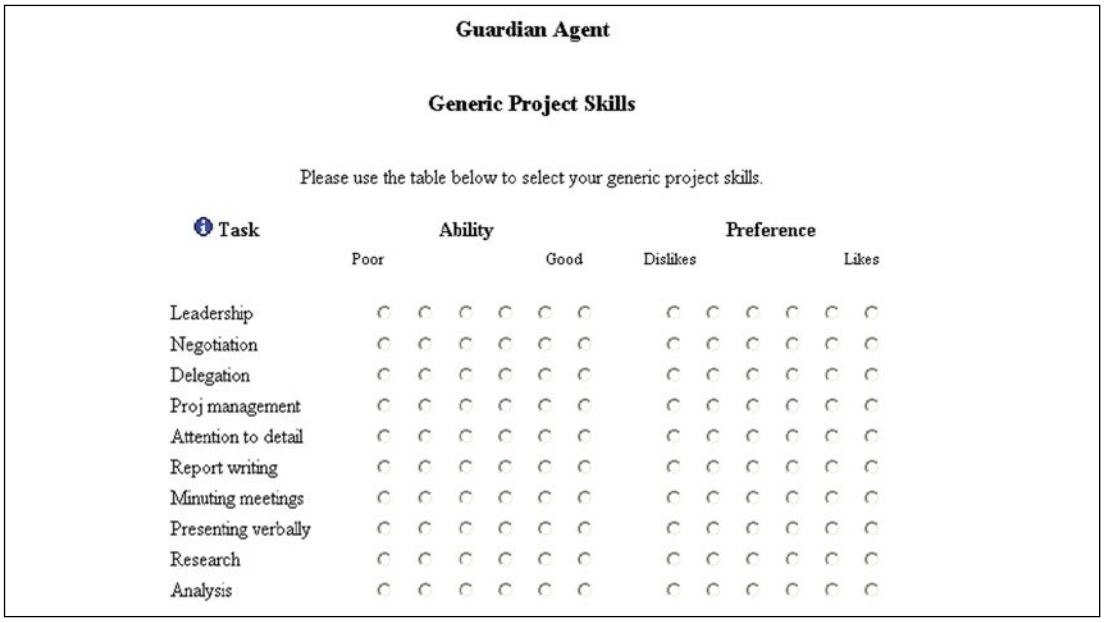

Figure 1. Screen shot of team member selection page for generic team skills.

The output from the system could be arranged by task area or by team member, as in the example given in Figure 2, where one team member has input a preference and ability in both leadership and negotiation skills, and another team member has input a preference and ability in presenting verbally, but only a preference for attention to detail, so the system has suggested some training in this for that team member. A short list of only three ground rules has been output in this instance, as the only suggested rules that more than half of the team members indicated were important. The system took on three different appearances over several annual cycles of the prototyping, between 2002 and 2008, and each successive version was amended according to feedback from the previous trial with students, and incremental addition of functions. These screen shots represent the final version.

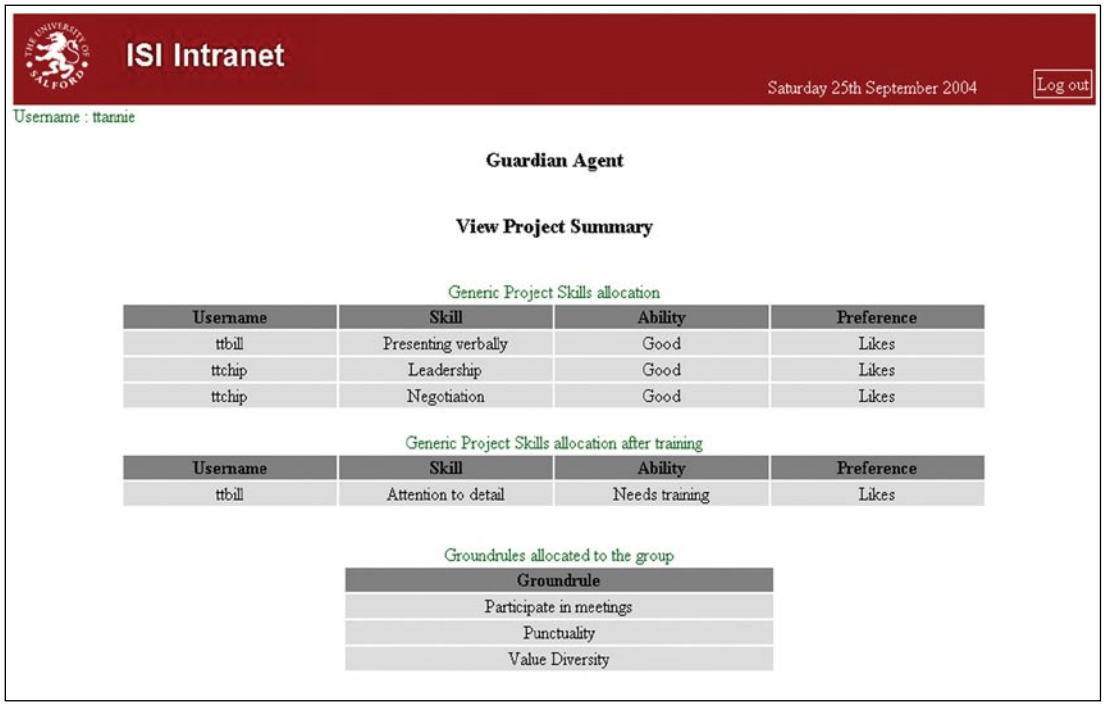

Figure 2. Screen shot showing typical output from the system, in team member format.

This prototype student team support tool was used with undergraduate students, working on multi-year team projects in a co-located setting. The students were taking one of several business information systems programmes of study, and teams were allocated to include students from first, second and final years of study, totalling between 10 and 15 students in each team. The projects undertaken were provided by outside organisations, which could include web design, database development or feasibility studies. Because of the variety of these projects the teams had a good deal of autonomy to organise the work as they felt was appropriate. All of the teams were asked, through their team leaders, to participate in the trials, by using the system at the beginning of their projects to allocate tasks to individual members of their team, a process that took about four weeks. In all about a quarter of the project teams used the system, team leaders opted in or out of the trials on behalf of their team members. As the system was designed for use at the beginning of the student team projects, the trials could only be conducted at the start of each academic year when the student teams started working on their projects, hence the long time frame for collecting data for this research.

After each trial of the prototype, students were asked for feedback on the system through answers to a questionnaire, an interview the researcher conducted with team leaders, and two focus groups, each of which had contributions from about 8 students. The questionnaire was designed by the researcher with the team project module tutor, and was given to each member of all of the teams that participated in the study. The questionnaire contained a combination of closed questions to ascertain the usefulness of the system to the individual, to their team and to online teams, together with open questions for respondents to identify changes, additions and other functions for the system. Quantitative analysis of this data was simply to gauge

the extent of agreement with the usefulness of the system. Comments from the open questions were analysed in a qualitative manner, along with the interview responses and focus group comments.

The interviews were conducted with team leaders from all of the participating teams, because these individuals had the most say in how output from the system was used. In addition, team leaders from two of the teams that had not used the system were interviewed, but using different wording for some of the questions. A semi-structured format was followed for the interviews by the researcher, and with probing from the researcher, much fuller details were gathered in response to the questions, for example on how successful the system was, how the output was used and good and bad aspects of the system. Interviews typically lasted between 20 and 40 minutes, and were carried out in a room near to the computer facilities. Focus groups were conducted to provide an opportunity for all team members from the participating teams to engage in feedback. Although only a few team members attended these (8 and 9 respectively), those who did were able to provide a great number of useful comments, to corroborate data from the other sources, and to provide new insights into the ways in which the teams used the output from the system. The sessions were recorded and the transcripts typed up later for analysis.

Qualitative analysis of the data was through sorting the comments according to whether they were related to possible modifications to the system, or were related to themes identified from the literature on student team working, such as developing skills, ground rules, expectations, project management, culture and team cohesion. These themes were based around how the output from the system was used to help the teams to get started on their projects, and the impact this output had on establishing team-working processes. In addition the findings were enriched by some quantitative results, which gave an indication of the extent of the impact of the software tool on their team working activities.

Over the four-year period of the trials about 30 teams used the prototype system, representing about a quarter of all of the teams. The response rate for the questionnaires was about 35%, but interviews were conducted with team leaders from all of the teams that had used the system.

4. Results from using the prototype system

Responses from the questionnaires enabled us to evaluate the level of acceptance by the students of the software tool. Analysing the data from all four years of the prototype use, 50% of those students who responded said that the system was useful to them. When asked if they thought the system would be useful to online student teams, 71% agreed that they thought it would be useful.

Interpretive research demands that the reasons for responses are identified, and the comments from students obtained through open ended questions on the questionnaire, the focus groups and in the interviews with team leaders, were analysed to gain richer insight into the students' use of the system.

4.1. Allocation of tasks

Although the students were divided over whether the system was useful to them, the team leaders were overwhelmingly in favour of using the system. Typical comments on the usefulness of the task allocation function from team leaders (TL) were:

> *"Yes, showed clearly the technical and other types of people." TL, 2003*
>
> *"...build a knowledge base of the skills existing and required and matched to the specification of the project" TL, 2004*
>
> *"It made them think about the skills, choosing them" TL, 2004*

However, there were comments from a few team leaders that this form of automation was not necessary, e.g:

> *"In my project it was cut and dried what needed to be done, useful if programming software, but as a research project, there is really no need for automation." TL, 2004*

The output from the system was used in different ways by some teams, which had not been anticipated at the design stage, and these could be signposted as possible actions in a future system:

"See all gradings for everyone. So if low mark can put with more confident person" TL, 2005

"Team project work is an opportunity to learn re new things, not just about what you can do and what you think you can do." Focus Group, 2002

"Another source to look at. Socialising is important. Something else to think about and help making decisions" TL, 2003

"Task allocation affected by motivation, allocate tasks using a risk analysis approach – don't allocate key tasks to high risk people" FG, 2002

"Problem that it is what each individual team member thinks they are good at, not what their aptitude is" FG, 2002

4.2. Ground rules

Few student teams had in the past considered setting ground rules for the team at the start of their projects. But this system encouraged good practice, which was recognised by some teams, as shown by these comments:

"Good to air the ground rules, no one was shy to talk about it" TL, 2004

"...getting people's opinions, success factors of the project" TL, 2004

"...by looking at the ground rules, the team had a better understanding of team working, and I based the contract on them..." TL, 2008

"Good to highlight to team at start, made them think about expectations" FG, 2004

"This [team spirit] is an important factor, [ground rules] help to understand how they work together and adapt to situations" TL, 2004

"Much team work is undocumented rules" FG, 2002

This last comment suggests that a lot more is going on in teams than can be formalised, and that this sort of system can be instrumental in guiding the student teams towards good practice.

4.3. Acceptance of the system

Most of the teams in this trial accepted the system, and readily incorporated the system and its output into their team working, but the culture of team working within the school was deep set, and comparisons were made with previous practice:

"Hard to get away from method used previously. Let's do what we normally do" FG, 2004

The teams in this study were working on campus, but many students accessed the system from home, so their comments would be a good indicator of whether the system would be useful for teams working mainly online:

"Yes it would be good online, where it would be very difficult to decide on the skills that each member had" TL, 2004

"We meet together to sort the next task, face-to-face [communication] is important, if online we would need some kind of structure, communication plan, e-mail, would be more useful" TL, 2004

"Even more difficult in virtual teams, to abide by ground rules, e.g. trust, culture develops in time." FG, 2004

4.4. Possible development for the system

Examining the comments made by the students provided possible reasons for the system's limitations in these trials:

> *"It needs to be communicated to all team members at the beginning, to introduce the tool." TL, 2008*
>
> *"Down to purpose, and explaining the purpose – if people understand that it is there to help them" FG, 2002*

One team leader appreciated that the system might have helped if used earlier, and another student recognised that the system would be useful to provide a holistic view of the project:

> *"Used earlier it may have speeded up the project, because the first tasks allocated would have been based on their preferences, and see how they got on with them." TL, 2008*
>
> *"...but people get on with their own work rather than look at project as a whole." FG, 2004*

The research did provide several suggestions for future developments of the system, which would make it more useful in this particular case, and which might make it useful for other cases as well:

> *"How to handle problems, what has happened in the past." TL, 2003*
>
> *"Deadlines to tick off. Agent would keep a record of deadlines" FG, 2004*
>
> *"..keeping up with tasks, assign tasks to members, monitoring of completion, for documentation" TL, 2003*

The system could provide the following features:

> *"More information on skills, e.g. report writing" TL, 2005*
>
> *"Feedback on carrying out documentation, what is expected, roles, responsibilities" TL, 2003*
>
> *"Look at how people have done on past modules (skills assessment) and undertake some form of 'measure'" FG, 2002*
>
> *"Online team shared workspaces, linked with project management for deadlines, update from home, and freely available." TL, 2005*
>
> *"Agent could act as the decision maker, skills assessment, which types of people would work well together" FG, 2002*

The comments in this section provided a snapshot of what many of the students, and in particular the team leaders, thought of the prototype system. In the next section the results will be discussed in the light of some of the literature on student team working, to determine the extent to which the system can help to develop team working and IT skills.

5. Discussion of the findings

Data from the surveys and focus groups provided informative feedback on the system as it was used in this case. Ways in which the system was used in practice differed from that whose which were anticipated, but demonstrated that there is a need for help to get the teams started on their team projects.

Feedback from the students that used the system suggests that this sort of software would be useful to help the teams to get to know each other's capabilities and preferences, and in this case the team leader was the main user of the output from the system. The team leaders used the output to allocate tasks, and using the suggestions for training needs, some allocated an individual with a low score on a skill area with someone who scored highly, so that one could teach the other that particular skill. They recognised the benefits of using the team project as an opportunity to learn something new. However, there were notes of caution expressed such that important project tasks were not allocated to a team member who was less trusted, and that individuals may not be honest in their grading of their abilities. The findings suggest that the grading

of ability levels in skill areas in the system was found to be a very useful means of communicating ability and preference within the team, which is something that existing groupware and student support system do not provide. As Corbitt and Martz (2003) suggest, this communication is needed to develop openness and trust within a team.

The ground rules function, although not used by all of the teams, was regarded as a useful prompt for discussion. Again this means of communication of ground rules preferences is a feature not provided by existing groupware or student support systems, but recognised by Hartley (1997) among others as essential for team cohesion.

Some students suggested that the system would be more useful for teams working online, as an additional support to replace some of the face to face meetings. The students in this case suggested several ways in which the system could be made more useful, such as introducing the system to the teams before they get started, and providing signposts to possible actions and uses of the output from the system. In addition they suggested enhancements, which although specific to this case, would provide additional support for team working to students in other disciplines.

6. Conclusions

This paper describes the evaluation of the usefulness of a software system developed to support students working on team projects. Using a case study approach, and through a series of prototypes of the system, the feedback from the students who tried the system showed that such a system was useful to them in getting started on their team project work. The ways in which the teams chose to use the output from the system was sometimes different to those envisaged by the designer, but highlighted a need for some form of support for team project work, particularly where student teams are dispersed, and this system did help to promote openness and trust.

The final prototype embraces two functions, and by considering the suggestions put forward by the students in this trial, a system that provides additional support and enhances the provision of existing groupware or VLEs is proposed.

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An analysis of first-year business students' mobile phones and their use for learning

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This paper reports on ongoing work into mobile learning that has been conducted with an incoming group of first-year Business Studies students over the last five years. A longitudinal study has been conducted with this student group over the period. The paper focuses on the data that has been gathered from this study, which offers an insight into the student cohort; what it tells us about the mobile phones that they own; their attitudes to using them, and in particular how they are using them for learning. How the survey will be followed-up with in-depth research with a small number of students is outlined. This work offers a valuable overview of the appropriation of mobile phones by students. It is timely to present our findings, given the recent 'New Horizon Report (2010) and its focus on mobile computing – one of six 'technologies to watch', by which we mean the 'use of the network capable devices students are already carrying'.

Keywords: *mobile learning, mLearning, students mobile phones, longitudinal study, higher education, HE, mobile phone survey, mobile phone use, learning with mobile phones, evidence*

1. Introduction

This paper presents ongoing research into mobile learning conducted with a group of first-year students at London Metropolitan University. Mobile learning has been introduced into the blend of teaching and learning activities gradually, aiming to make use of the increasingly powerful mobile phones that the students have, to enhance engagement, communication and learning in a range of learning scenarios. Underpinning these pilot activities, is a longitudinal study in which a survey has been conducted with the student group for the past five years, which gives us data about these students, their mobile phones, their attitudes to using them, and how they are using them for learning. It is the results from this survey that are the main focus of this paper, but the paper briefly discusses previous work to put our research into perspective, and also outlines the direction of current research, which is looking in more depth at how students are currently using their mobile phones for learning.

It is timely to present our findings about student mobile phone use, given the recent 'New Horizon Report' (2010) and its focus on mobile computing – one of six 'technologies to watch', by which we mean the 'use of the network capable devices students are already carrying'. The report further identifies, "the fastest growing sales segment belongs to smart phones – which means that all over the world a massive and increasing number of people now own and use a computer that fits into their hand and is able to connect to the network wirelessly from virtually anywhere". Furthermore, figures from the recent GSMA Mobile Media Metrics report show that Internet access from mobile phones is increasing in the UK: more than 25% of the population (16 million people) accessed the Internet from their mobiles in December 2009 (Guardian.co.uk, 2010). The highest accesses were for Facebook, followed by Google and a range of other websites.

Mobile devices have a number of important characteristics which make them attractive from an educational perspective, including increasing portability, functionality, multimedia convergence, ubiquity, personal ownership, social interactivity, context sensitivity, location awareness, connectivity and personalisation (Pachler et al, 2010). We know from the results of our student survey that all students now have mobile phones that are becoming increasingly sophisticated, and they are keen to use them for learning outside the classroom.

Mobile learning definitions tend to be based around the mobility of the device, the learner, or on the facilitation of informal learning beyond the confines of the classroom (Laurillard, 2007; Sharples et al, 2007; Wali et al, 2008). We view mobile learning as learning that takes place using mobile devices at a time and in a place that is appropriate and convenient to the learner. This can be both within and outside the classroom, and indeed there are examples of where mobile learning can bridge the gap between formal and informal learning (e.g. Cook, Pachler & Bradley, 2008). Outside of the classroom, the use of mobile devices provides more opportunities for learning, allowing students to have more choices in where and how and when they learn. There is also a growing body of evidence coming from a number of studies that show that using mobile technologies can help to engage some students into taking part in learning activities (e.g. Savill-Smith 2005, Bradley et al, 2009).

Traxler, (2007) discusses the affordances of mobile learning and the contexts within which mobile learning may be situated, and that how it develops will depend in part on the affordances of any given situation. There are clearly many appropriate contexts for mobile learning, but our current line of research is to explore the contexts that students are themselves adopting so that we can harness the powerful technologies they have and carry around with them, and encourage wider adoption of these practices.

In this paper we briefly discuss previous work to put our research into perspective, followed by an analysis of the data, and we conclude by outlining the direction of future research.

2. Background

First-year students at London Metropolitan Business School all take a core module designed to assist them with settling into Higher Education. The student body is diverse: there are many mature learners who are returning to education and overseas students who do not speak English as their first language, many of whom have just arrived in the country to study. In an effort to engage these students (of whom only 12% enter with a traditional 'A' level profile), the curriculum was redesigned to facilitate blended learning, where students could access materials at a time and place of their own choosing, yet be fully supported in the classroom. The curriculum is designed around a visit to the Tate Modern Art Gallery, with student activities scaffolded by an interactive website used both inside the classroom and for independent study [http://learning.londonmet.ac.uk/LMBS/quickstart]. Web statistics for the site showed a tremendous response from the students, with visits made 24 hours a day every day of the week, illustrating engagement in this aspect of the module (Holley & Dobson, 2008).

In 2005, the first survey into students' attitudes to mobile phones revealed a willingness to experiment with learning via their mobiles. This justified the trial introduction of a commercial package, mediaBoard [www.mediaboard.co.uk/apps/demo/] to encourage the sharing of materials and facilitate groupwork online (Cook at al, 2006). mediaBoard enables students to upload images and SMS messages from their mobiles (or a PC) to an online shared group space. This was followed by the introduction of 'student study tips' the following year where the lecturer texted the students learning tips to scaffold their presentation research. More recently a text messaging system 'TxtTools' [www.txttools.co.uk] has been incorporated within large lectures, to encourage students to ask questions by sending them in as SMS messages and thus engage and participate in the lecture to a greater extent (Holley et al, 2010). These trials have introduced mobile learning into the blend of teaching and learning activities, aiming to enhance student engagement, communication and learning.

However, the use of commercial systems such as mediaBoard and TxtTools require funding and commitment from the University to be sustainable. In our current area of research we are looking to utilize the devices that the students have and what they are already using them for.

The next section presents the survey results, accompanied by analysis and discussion of the key emerging issues.

3. Survey results and discussion

A longitudinal study has been conducted with first-year students taking a core business module, 'Studying Marketing and Operations'. Students completed a short paper-based questionnaire in about Week 4 which asks about the mobile phones they have, their views of using their devices for learning and what they use them for. The data from the last five years (since 2005) is presented in this section. Grounded theory has been used to analyse the qualitative data in order to explore the student situation and what it is telling us about their mobile phone attitudes and uses (Strauss and Corbin, 1998).

3.1 The students and their mobile phones

The following tables provide information about the students that have completed the survey and the mobile phones that they own. Table 1 shows the number of students that have completed each survey, their gender and age.

Date	No. of students in sample	Gender No. of females	Age range				
			18-20	21-25	25-30	30-35	36+
2005	69	67%	60%	25%	10%	3%	2%
2006	101	71%	45%	37%	10%	3%	5%
2007	65	69%	53%	36%	8%	3%	0%
2008	91	68%	49%	45%	4%	2%	0%
2009	76	72%	61%	33%	5%	1%	0%

Table 1. The students in the study

Between 65 and 101 students have completed the questionnaire each year, thus providing us with a reasonable sample size. In each year about 70% of the students are females, and the majority is aged between 18-20, with 21-25 the next largest group. Only a small percentage is over 25. This student profile reflects the module cohort as a whole, which is similar each year, being predominantly female and in their late teens/early twenties (a significant number of fashion marketing students study this module).

Table 2 shows the level of mobile phone ownership and the proportion of students that have their mobile on contract (rather than 'pay as you go').

Date	No. of students owning a mobile phone	No. of students with a mobile phone on contract
2005	98.6% (1 didn't)	46%
2006	100%	49.5%
2007	98.5% (1 didn't)	58.5%
2008	100%	57%
2009	100%	63%

Table 2. Mobile phone ownership

In 3 out of the 5 years all students have owned a mobile, the exceptions being in 2005 and 2007 when 1 student in each year did not (both were international students waiting for an ordered phone to arrive). The data show an increase in the number of students that have their mobile on a contract over the period. Contracts usually provide inclusive call-time and SMS messages, and more recently data downloads. The implication is that if students have inclusive minutes, texts and data downloads within their monthly tariff, they will be more likely to use their mobile phone, and for University-related activities as well. There is a concern that students may be put-off from using their mobile for what could be considered 'non essential' tasks (such as for University) because of the costs incurred. In 2009 63% of the students had their phone on a contract.

We also asked which mobile phone they owned, but the results are not presented in detail here, as the number of different models owned is large each year, ranging from 11 different models in 2008 to 49 in 2007. However, there is definitely a trend in the data that shows that the sophistication of the owned devices increases each year, with more and more students owning smart phones. In the 2009 sample for example, 14 had Blackberry's and 6 had iPhones. This trend is also reflected in the features that their devices have (see Table 4).

Date	6 months	12 months	18 months	As long as possible
2005	9.5%	38%	36.5%	16%
2006	9%	36.5%	18%	36.5%
2007	10%	39%	14%	37%
2008	13.3%	38.9%	18.9%	28.9%
2009	1%	37%	27%	35%

Table 3. Length of time students keep a mobile phone for

Table 3 shows how long students are likely to keep a phone for. This provides a measure of how frequently new devices are acquired, each one generally having greater functionality than the previous one. The data shows that the largest number of students (just over a third) keep a phone for 12 months, but a high proportion in each year also like to keep their phone for 'as long as possible'. Recent changes increasing the standard period of contracts to 18 months are also reflected in our data.

The real indicator of what students can do with their phones is shown in Table 4, features of mobile phones. Features have been added to the survey over time as they became introduced into handsets, so if a feature did not appear in the survey in that year, the result appears as 'N/A' in the table.

Date	Colour screen	Camera	Record video	Record audio/ voice	Internet / WAP	Wifi	Bluetooth	3G	GPS
2005	68%	68%	N/A	N/A	56.5%	1.4%	41%	14.5%	N/A
2006	88%	83%	78%	77%	75%	14%	80%	21%	N/A
2007	92%	89%	85%	83%	72%	15%	83%	28%	31%
2008	94.5%	96%	83.5%	80%	80%	22%	97%	32%	39%
2009	97%	96%	86%	84%	80%	50%	91%	46%	50%

Table 4. Features of students' mobile phones

The data show that the proliferation of all features has increased over the years (apart from a minor blip in some years for some features). Colour screens are now standard for 97% of the students. The ability to be able to capture and generate content is also a possibility for a high proportion of students: 96% have a camera, 86% can record video and 84% can record audio/voice. The ability to access data networks and share data has also increased over the years. In 2009 80% of students can access the Internet from their mobiles. 50% can access WIFI, which is important as it enables students to have free access to the Internet and other data sources. 91% now have Bluetooth, 46% 3G and 50% GPS.

3.2 Students' attitudes to using their phones for learning

Three questions were asked about their attitudes to using their mobile phone for learning and being contacted by the University. The graph in Figure 1 plots the responses to the question 'How much is the ability to learn at any time and in any place important to you?' which was designed to find out about their attitude towards flexible learning, and therefore potentially mobile learning.

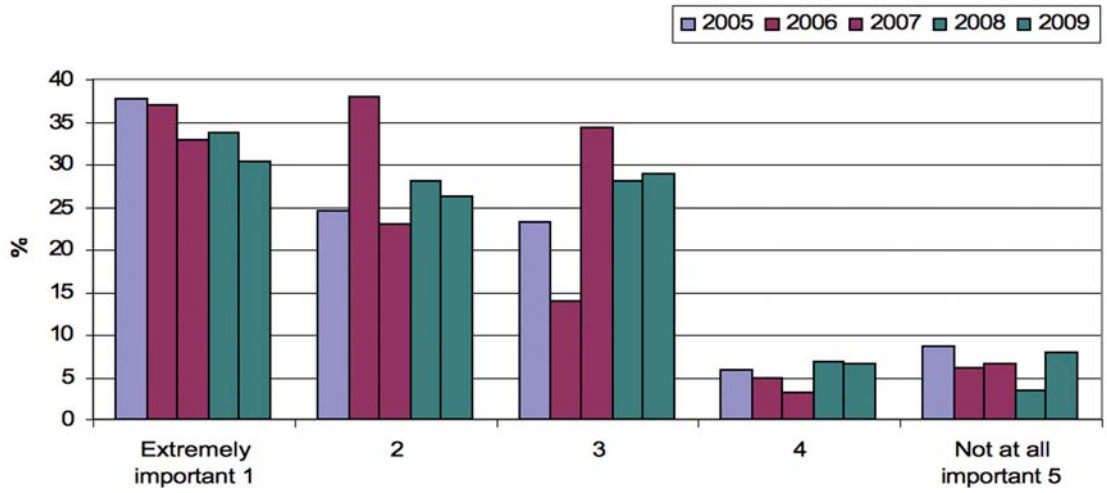

Figure 1. How much is the ability to learn at any time and in any place important to you?

One pattern which can be seen in the data is that those who answered '1' on the scale of it being important, are on the whole in the majority – responses range from between 30-38% of students, and show a slight decline over the years (30% rated '1' in 2009). There is also a reasonable number of students who rated '3' in the middle, and were thus undecided or unsure – responses range from 14-34% (26% in 2009). However the views are either positive or undecided on the whole, with low numbers of responses at the negative end of the scale – responses to '4' ranged between 3-5%, and '5' from 3-9%. We can deduce from these results that a large number of students are open to the idea of learning at any time and in any place that is important to them.

Figure 2 explores the question 'How useful would it be to access learning materials via your mobile?', as earlier research explored developing learning objects for mobile phones.

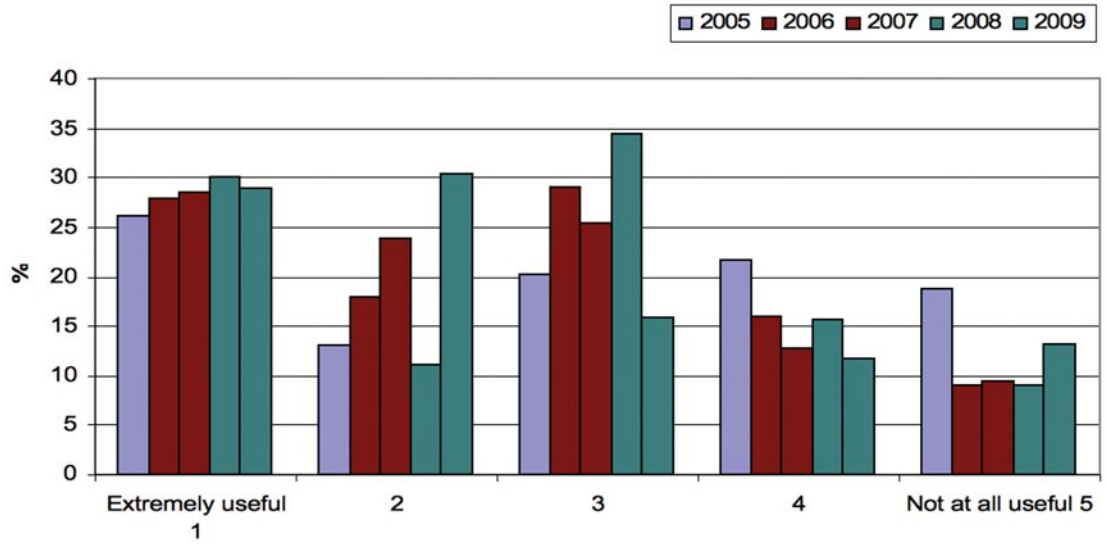

Figure 2. How useful would it be to access learning materials via your mobile?

The results are not easy to interpret for this question, but between 26-30% have chosen '1' on the scale, so the results over the years are consistent for this rating, indicating that just over a quarter of students each year think it would be extremely useful. Between 16-34% have answered '3', and at the negative end of the scale between 12-22% have answered '4' and 9-19% have answered '5'. Some explanations for the more reticent opinions could be that students do not feel that they have a phone that would facilitate this, or maybe some are concerned about the cost implications that could be involved in downloading or accessing

materials online. It is also possible that some students are not able to visualise what learning materials could be like on a mobile (they will think of the online learning materials that are available within the module in WebLearn, the institutional Virtual Learning Environment, some of which are quite sophisticated). This is one area that we intend to follow-up in our in-depth study with students.

Figure 3 shows the responses to the question 'How would you view the university contacting you via your mobile for learning purposes?' which aimed to find out how 'personal' students viewed their mobiles and whether they were against what could be perceived as intrusive activities.

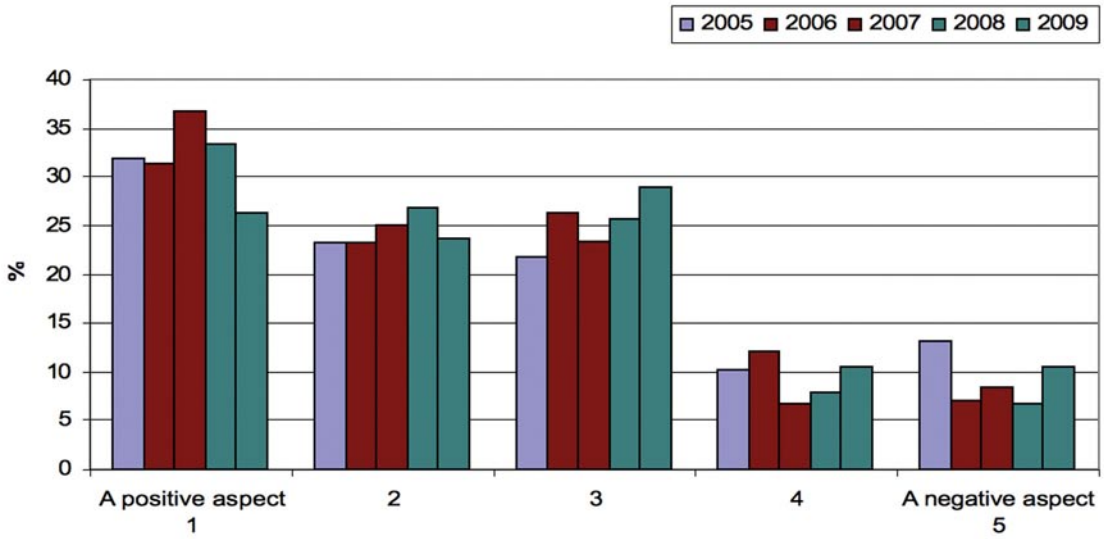

Figure 3. How would you view the university contacting you via your mobile for learning purposes?

The results for this question are relatively consistent across the 5 years. Between 26-38% answered '1' and 23-27% answered '2' at the positive end of the scale. Those answering '3' and somewhat undecided ranged between 22-29%. Answers at the negative end of the scale were relatively low: between 7-12% for '4' and 7-13% for '5'. Again, there are large numbers of students who are positive, and also a reasonable number who are undecided. In 2009 '3' was the mode response (29%), and 26% answered '1' and 24% answered '2'. One factor influencing answers here may be that this question could be interpreted as 'other parts' of the university, such as administrative contact, which could be considered to be unhelpful and intrusive. One of the problems of getting attitudinal feedback via a questionnaire is that the reason behind students' answers cannot be explored further. However, we intend to investigate student perceptions in this area further in our in-depth study which will follow.

3.3 How students use their mobile phone to help with their learning

The final question was 'Do you currently use your mobile phone to help with your learning?', and if so, what do you use it for? This is the question that is most pertinent to our current research, and is interesting as it reveals what students are actually using their mobile devices for. This question was introduced into the survey in 2007, so we have data to compare from the last 3 years (see Table 5).

Date	No. of students answering 'yes'	% of sample answering 'yes'	No. of different uses cited
2007	8 (n=65)	12%	12
2008	16 (n=91)	18%	25
2009	22 (n=76)	29%	34

Table 5. Do you currently use your mobile phone to help with your learning?

In all years, some students have cited more than one use. Both the percentage of students using their mobiles and the uses they are putting them to have increased in each subsequent year. In 2009 nearly a third of the students reported using their mobiles for learning (29%), citing 34 different uses.

All of the uses cited by each student have been grouped into categories (such as communicating, using tools etc.) and are presented in tables 6 to 8 below for each year.

Category	Mobile phone use	Total uses per category
Communicating	I always call people to ask about homework Contact my assessor on an external course Calling other students Receive text messages from lecturers	4
Using tools / applications	Calculator (3 students) Converter	4
Organising	Organiser Reminder	2
Generating content / artefacts	Take pictures of potential images that aid my research	1
Other	Group work	1

Table 6. How students use their mobile phones to help with their learning – autumn 2007

In 2007 12% of the students (8) cited 12 uses of their mobile phones for learning, and these have been grouped into 4 categories: 'communicating', 'using tools/applications', 'organising', 'generating content/ artefacts' and 'other' (other uses that did not seem worthy of adding another category). The categories 'communicating' and 'using tools/applications' each had 4 entries. Calling people was cited by 3 students and receiving text messages by one. In the 'using tools/applications' category, 3 said they used the calculator and one the converter. In the 'organising' category, one used the organiser and one the reminder. In the 'generating content/artefacts' category one student said they used their mobile to "take pictures of potential images that aid my research". In the 'other' category, one cited group work (but didn't explain how their phone was used for this).

Category	Mobile phone use	Total uses per category
Communicating	Calling friend to ask them about studying stuff Contacting group members to discuss work Communicate with other students Texting/SMS (2 students) Texting during lectures VOC. from text messages	7
Using tools / applications		0
Organising	Timetables (3 students) To find the lesson's time and where it is Schedule	5
Generating content / artefacts	Pictures	1
Conducting research / getting information	Internet (2 students) Google (3 students) Wikipedia Finding out information Research	7
Notetaking	Saving useful information because I always have access to it Notes	2
Other	WebLearn (2 students) To record lecture	3

Table 7. How students use their mobile phones to help with their learning – autumn 2008

Table 7 shows the responses from 2008, where 18% of the students (16) cited 25 uses of using their mobiles for learning, more than double the number of uses cited in 2007.

It is significant that two new categories of use have emerged: 'conducting research/getting information' and 'notetaking'. Two categories 'communicating' and 'conducting research/getting information' each had 7 uses cited. In the communication category, 4 mentioned text messages, 1 mentioned calling, and 2 mentioned contacting or communicating with others without mentioning the specific form of communication(s) used. In the 'conducting research/getting information' category, the "Internet" and "Google" were each mentioned twice, and the other 3 cited "Wikipedia", "finding out information" and "research". We have made the assumption that if students were using the Internet for learning, they were likely to be using it for 'research/getting information', and likewise if they were using Google and Wikpedia. Two students were using their phones for 'notetaking'. In the 'other' category, 2 used their mobiles for WebLearn (the University's VLE) and one "to record lecture". In the 'generating content/artefacts category' only one use was cited "pictures". No uses were cited in the 'using tools/applications' category.

In 2008 the survey shows that for the first time students were using their mobile phones to access the Internet to help with their research, and were starting to use them for notetaking. Two were accessing WebLearn, although they did not specify what for (the module makes good use of the VLE, providing a week by week schedule with links to online learning objects and podcasts for some topics).

Category	Mobile phone use	Total uses per category
Communicating	Email (2 students) Saving emails To receive emails Contacting group assignment members Fashion facebook group	6
Using tools / applications	Calculator (3 students) Microsoft Office	4
Organising	Putting reminder alarms for meetings Check my exams Organiser	3
Generating content / artefacts	Take pictures/photos (3 students) Voice recording	4
Conducting research / getting information	Internet (4 students) Google (3 students) Research (2 students) Researching on the Internet Accessing info pages Search information	12
Notetaking	Write notes	1
Other	Accessing learning materials Presentations Record presentations Transport files (PDF, Word, Powerpoint ...)	4

Table 8. How students use their mobile phones to help with their learning – autumn 2009

Table 8 shows the results from 2009, where the number of students using their mobiles for learning had increased to 29%, with 22 students citing 34 different tasks, all of which could be aligned with the same categories from 2008.

The category seeing the largest area of growth was 'conducting research/getting information', where 12 uses were cited. 8 mentioned using the Internet (5 directly mentioned the Internet and 3 mentioned using Google). The 'communicating' category saw 6 uses cited: 4 mentioned email which had not been mentioned in previous years, 1 mentioned "contacting group assignment members" and social networking makes an

appearance with 1 citing "fashion facebook group". The 'using tools/applications' category saw 4 uses, with 3 mentioning "calculator" and 1 "Microsoft Office". The use of Microsoft Office is interesting here, as for this student, their mobile phone is clearly taking over some of the functionality of their PC (this student owned a Blackberry Curve).

There was also an increase in the 'generating content/artefacts' category, with 4 uses cited: 3 mentioned taking "photos/pictures", and one "voice recording". The 'Other' category also saw an increase: 2 mentioned using their phones for presentations, and two new uses emerge, "accessing learning materials" and "transport files (PDF, Word, Powerpoint ...)", other indicators that students' mobile phones are becoming more sophisticated and that they can use them for a wider range of activities. The 'organising' category saw a decrease to 3 uses: "putting reminder alarms for meetings", "check my exams" and "organiser". The 'notetaking' category had one use cited, "write notes".

The extent to which students' mobile use has been influenced by tutor-led mobile learning activities is difficult to assess. In 2007 and 2008 the lecturer experimented with using text messages to engage students, but most of the uses that students cite do not reflect this, and suggest that what they are doing is of their own initiative. Conversations in class with the lecturer, however, indicate that some students are unaware of, or had never considered using their mobiles as a study device, leading us to believe that making students aware of what they can do with their phones may encourage wider appropriation.

4. Conclusions

The number of students using their mobile phones for learning in 2009 is not a large proportion of the sample (29%), but there is clear evidence that the number is increasing each year, along with the range of uses for which they are appropriating them. Comparing the data from the last three years, the most noticeable change is that students are increasingly using their mobiles to access the Internet and get information for research, more than using their phones for communication which was common in 2007 and 2008. We do, however, see the emergence of students using their phones for email for the first time in 2009. In 2009, another area of increased use is for 'generating content/artefacts', with students taking photographs and making audio recordings. The growth in these two areas (Internet access and user generated content) and the increase in the range of tasks for which students use their mobiles, is made possible by the increased sophistication of the devices they own. This is evident from the data presented in Table 4 earlier, 'Features of students' mobile phones'. Not only has device sophistication increased over the five year period, but in our 2009 sample, 80% can access the Internet, 96% have a camera, 86% can record video and 80% can record audio, clearly illustrating that students have the capabilities in their mobile phones to engage in a wide range of learning tasks. Our results are also in line with the mobile phone ownership and usage findings reported in the New Horizon Report (2010) and GSMA Mobile Media Metrics report (2010) outlined earlier, which showed that smart phones are increasing, along with Internet access from mobile phones. Not only do students have the capabilities, they are appropriating their phones for learning purposes, and demonstrate a range of learning activities.

When we started the student survey, one of the main aims was to ascertain how many students had mobiles (to ensure that no student was disadvantaged by any mobile learning developments), what devices they had and what they could do with them. Our study shows that we can now assume they will all have a device and the emphasis of our research has switched to how they are using their phones for learning and what tasks they are using them for.

Whilst the results from our survey may not be indicative of all students, it does provide an insight into the current practice of these students, and gives underpinning data that inform our work with them. The next stage in our research is to explore individual students' use in more depth to capture their experiences. We have funding for a small project that will lend students flip video cameras to record examples of their mobile phone use for learning. Afterwards we will ascribe meaning to their actions via one-to-one interviews. The results, in the form of some case studies of student practice, will be publicly available on the project website [http://www.londonmet.ac.uk/learningonthemove/index.html] along with some resource materials designed to encourage students and tutors to make more use of the powerful mobile phones that students increasingly have.

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Electronic resource discovery systems: do they help or hinder in searching for academic material

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Higher Education libraries are spending a significant proportion of their learning materials budget on electronic resources: e-books, full-text databases and back copies of e-journals. However, the use of these resources is relatively low among the undergraduate students. Instead students are increasingly using external resources such as Google and YouTube to help them start in their searches. This paper reports on a qualitative study of students and researchers in Business and Economic using institutional electronic resource discovery systems (ERDSs) when searching for quality academic material. In addition, it discusses which resources are most popular and why, as well as the difficulties and challenges the current ERDSs present to users. Based on the findings of the study, recommendations for resource discovery systems will be presented in order to improve the use of these resources by higher education students and staff.

Keywords: *electronic resource discovery systems, recommendations, usability, qualitative research, library resources*

1. Introduction

This paper focuses on providing evidence of how ERDSs help or hinder students and researchers information seeking activities when searching for quality materials using various electronic resource discovery systems.

Higher Education (HE) libraries in the U.K. are spending a significant proportion of their learning materials budget on electronic resources: e-books, full-text databases and back copies of e-journals. According to Research Information Network Report (RIN, 2009), UK universities spent £79.8m on licenses for e-journals in 2006/07 out of a total serials expenditure of £112.7m.

It is generally perceived by librarians and teaching staff alike that a significant number of students are not accessing the quality library-subscribed resources and are indeed more than ever using Google as their first port of call to obtain information for academic study (Fieldhouse, 2008). Highly complex resources with poor usability, difficulties in finding and accessing the resources, difficulties dealing with multiple paradigms and interfaces across systems and a poor understanding of the content of resources are some of the reasons for this deliberate avoidance of ERDS use. When using these resources users need to know not only the procedure for accessing a particular resource (e.g. a full-text or index of articles database) but also, to some extent, need to have an understanding of the way each ERDS is structured thereby limiting their searching. Users also need to have an understanding of the scope and searching mechanisms on each of the different ERDSs which makes searching each ERDS both time-consuming and cumbersome. These limitations create a barrier toward generating fluid information search and retrieval processes and distract users from focusing on the content, critically analysing and evaluating resources and generally making sense of information in order to enhance the learning experience. Details of this study have been reported elsewhere (Wong et al., 2009).

Many HE libraries are responding to the challenges presented above by ensuring that their collections are linked to Google Scholar and overlaying new technologies above the plethora of subscribed and free resources now available online (subscribed and free). Some of these technologies include the federated search engines and link resolver systems and third-generation OPACS or vertical search engines. Some UK HE institutions have also eased access to online resources through a single sign-on so that students can authenticate and access resources from their Virtual Learning Environments (VLEs) without the need to authenticate more than once. Despite these 'band-aid' measures, the overall picture is a confusing one and is

often characterised by a reactive and fragmented approach rather than one based on a coordinated strategy with a clear vision. Many of these issues have been highlighted in the JISC SCONUL LMS Report (http://www.jisc.ac.uk/whatwedo/programmes/resourcediscovery/libraryMS).

For the research reported in this paper, we conducted a qualitative study comprising 34 students and researchers from three universities representing the three categories of UK universities: a large research-intensive university, a smaller research-led university and a former polytechnic which became a new teaching and research university. We applied a combination of Cognitive Task Analysis methods such as observations, 'think aloud', interviews with Critical Decision Methods (CDM) and cued recall, in order to identify and understand the ways students and researchers search for quality information using various ERDS.

The remainder of the paper is structured as follows: Section 2 describes what we did, Section 3 presents what we found, and we present our discussion and conclusions including suggested recommendations in Section 4.

2. What we did

We adopted a qualitative research approach to identify, understand and compare the information seeking behaviours of scholars searching for quality materials. The study sought to gather data about the process that users follow when searching for information including the stages that influence the choices that they make in what resources to consult as well as their searching behaviours whilst using different electronic resource discovery systems.

2.1 Participants

In total 34 volunteers (16 female and 18 male, aged between 22-55 years) undergraduates (UG), postgraduates (PG), and post-doctoral researchers (Experts) in Business and Economics were recruited for the study (Table 1). Participants were given pseudo-names (e.g. MP2, LP5, CP4) in order to maintain their anonymity.

2.2 Data acquisition methods

		Under-grads	Post-grads	Researchers	Total
Stage 1: Focus Groups		6	3	0	9
Stage 2: Observations and in-depth interviews	Large research intensive university	5	4	3	12
	Former polytechnic	5	3	4	12
	Smaller research-led university	0	6	4	10
	Total	**10**	**13**	**11**	**34**

Table 1. Distribution of participants across universities

The study was initiated with two focus groups (9 students), which enabled us to identify the vocabulary that users use and understand in the context of electronic resource discovery systems during their search and query formulation as well as to identify resources that are used when searching for scholarly materials. The focus groups also enabled us to develop three task scenarios of varying levels of difficulty and ambiguity that were used in the next stage of the study. Focus groups are a qualitative method, which can be used alone or with other qualitative or quantitative methods to improve the depth of understanding the needs and requirements of users and customers (Vaughn et al. 1996, Payne, 1999).

The next stage of the study consisted of a 2-hour observation and 'think aloud' session with each of the 34 participants followed by an in-depth interview using Cognitive Task Analysis techniques such as observation, think aloud and interview together with cued recall.

User observation was combined with a 'think aloud' method and aimed to investigate what people do, and how and why they do it when seeking information within various electronic resource discovery systems. The participants were asked to think-aloud, i.e. to report what they were thinking as they carried out three information search and retrieval tasks. These tasks were of increasing levels of ambiguity and difficulty. Tasks were given to the participants in order: Task 1 to 3 and they are briefly presented below:

Task 1: Find a range of examples from film and television programs, which illustrate product placement 'in action'.

Task 2: Find evidence of film tourism from a range of different film industries to illustrate the impact this may have had on tourism.

Task 3: Imagine that you are the brand manager for a new range of mobile phones for Nokia; you required to produce evidence to demonstrate how you might use the film/television medium as a way of reaching your target audience.

Each session lasting between 40 – 80 minutes was screen recorded and later transcribed for analysis.

Following each observation session we carried out an in-depth interview that provided supportive evidence for the observation sessions. For the interviews, which followed the observations, we adapted the Critical Decision Method (CDM) (Hoffman et al., 1998; Klein et al., 1989, Wong and Blandford, 2002), which was combined with another cognitive task analysis technique called Cued Recall (Omdei et al., 2005; Puff, 1982). The Cued Recall technique helped us further probe aspects of the participants' interaction that we did not understand or had doubts about. The interviews focused on the following: (i) identifying the expertise and underlying rationale for the search behaviour demonstrated during the observation session; (ii) problems and difficulties users experienced; (iii) clarifying ambiguity that occurred during the observation session; and (iv) exploring the differences between services and attributes of physical and electronic libraries. Each interview lasted between 40 – 60 minutes was audio recorded and transcribed for subsequent analysis.

2.3 Data analysis method

We applied the Emergent Themes Analysis (ETA) approach (Wong and Blandford, 2002; Wong, 2006) to analyse the data, a technique for rapid yet systematic and rigorous extraction of key themes from both the observations and interviews of all studied participants. The ETA is based on Grounded Theory but takes advantage of the exploratory and efficient CDM data collection method (Wong, 2006). It uses a concept distillation process to rapidly and systematically identify broad themes and then sub-themes that are similar in ideas and concepts that are reported across interviews or observations. The data can then be identified, indexed and collated. The themes and sub-themes emerge from the data strengthening the validity of the findings.

3. What we found

3.1 Electronic resource discovery systems: popularity of use

Through an analysis of the most popular electronic resources amongst the participants, we discovered that 'internal' resources, which are library-subscribed EBSCO databases, Emerald or ProQuest were more frequently used by Expert and Postgraduate groups, whereas the 'external' resources such as the Internet resources including Google, YouTube or Yahoo were more often used by Undergraduate students (see Table 2 & 3).

3.2 Electronic resource discovery systems: making choices

Before beginning an information seeking session users made choices of resources used. The choices were influenced by: (i) the 'power' of bringing searches together; (ii) knowledge of the subject; (iii) prior knowledge and experience of resources; (iv) knowledge of strengths and limitations of the resources; (v) user's perception of trust towards resources; and (vi) usability of resources. In addition, the choice of resources was influenced by the recommendations, training and support provided by the institutions.

		Middlesex	Cranfield	LSE	Middlesex	Cranfield	LSE	Middlesex	Cranfield	LSE
		UG	UG	UG	PG	PG	PG	EX	EX	EX
	Number of participants	5	0	5	3	6	4	4	4	3
RESOURCES USED	Course reading list			1						
	EBSCO	1		1	3	5		2	2	1
	Emerald				1	1		1		
	Factiva					2			1	
	Free web resources			2						
	JISTOR				1					1
	Beta catalogue			1						1
	Library catalogue	1		3		1	1	1	1	1
	Library cross search					1	1		1	
	Library electronic resources A-Z					1		1		
	Library subject resources									1
	E-Journals	1		3		1		1		2
	Mintel							1	1	
	Library multisearch	1			1			1		
	ProQuest					2			2	
	Science Direct									1
	Business Insights							1		
	Business Source Premier			1		1				1
	Library quick search									1
	Archive Catalog			1						
	Amadeus					1				
	Info M25			1						
	Sage Journals Online				1					
	Financial Times				1					
	Academic Lib E-Book			2						
	Number of resources used =	4		10	6	10	2	8	6	9

Table 2. Most frequently used resources: Internal

		Middlesex	Cranfield	LSE	Middlesex	Cranfield	LSE	Middlesex	Cranfield	LSE
		UG	UG	UG	PG	PG	PG	EX	EX	EX
	Number of participants	5	0	5	3	6	4	4	4	3
RESOURCES USED	Google	4		5	3	5	4	3	4	3
	Google Books					1				
	Google Scholar	1		1	3	3	3	2	3	1
	Google Image	1				1				
	Wikipedia	1		1		2	1	1	1	2
	Yahoo				1					
	YouTube			1	2	2	2	1	1	1
	British Library			1						
	BBC News			1						
	NY Times						1			
	Lonely Planet					1				
	www.Bhaya.Fry					1				
	www.Askjeeves.com	1								
	19th Century BL Newspapers	1								
	www.cbc.com				1					
	Number of resources used =	**6**		**6**	**5**	**8**	**5**	**4**	**4**	**4**

Table 3. Most frequently used resources: External

3.2.1 The 'power' of bringing searches together

Participants perceived institutional federated search engines (such as 'MultiSearch', 'CrossSearch', and 'QuickSearch') as beneficial due to their ability to search across different resources. Referring to MultiSearch, "... it brings out the maximum possible results it can find at the university website and databases" (MP2, PG). Moreover, the reason for using the 'internal' resources lies in the quality of information they provide: "The academic databases are thought to be more reliable than Google" (CP5, PG).

However, most participants were unaware of the sources of information, i.e. they did not understand how the federated search engines worked nor what the differences were between the different sources of information, i.e. the scope of the different databases. Participants also reported not paying attention to the names of the journals that they found the information from but rather on the relevance of the information.

3.2.2 Knowledge of the subject

The assumption that you need to have knowledge about the subject before using these resources was one of the factors preventing participants from using the 'internal' resources. "In the marketing databases ... they have different categories: business, consumer goods so I have to know what to check" CP5 (PG). The lack of prior knowledge was evidenced when MP10 (UG) selected only 'EBSCO's Film & TV Literature Index' with 'Full Text' to search for 'product placement' rather than doing a simultaneous search on both the Business Source Complete and the Film & TV Index.

3.2.3 Prior knowledge and experience of resources

Another factor that influenced users' decisions about the resources used was prior experience. LP7 (EX) stated: "Let me try the beta catalogue. I remember that this was useful for wide searches". Participants often tend to use 'external' resources rather then 'internal' as they found them easier to use and they knew that these resources would provide some results whereas 'internal' resources would offer none or very low number of results.

3.2.4 Knowledge of strengths and limitations of the resources

The strengths and limitations of different resources were more known to Experts than UG and PG and they tended to rely more on 'internal' resources than the Internet. For instant, CP5 (PG) says with reference to the Social Science Research Network (SSRN), "I know that this site will not give me the full papers but will give me the names [i.e. references]".

3.2.5. User's perception of trust towards resources

Google and Google Books were perceived by participants as trustworthy in providing reliable, relevant, and of high quality materials. "It came from Google Books so it'll be ok" (LP2, UG). In addition, these resources were perceived by some participants as 'turn for help' when they needed to regain their 'bearings'. "I will go back to Google to help me get my bearings ... " (LP7, EX).

3.2.6 Usability of resources

Users' decision to use one resource over another was also influenced by usability issues. Some found using 'external' resources easier to use than the 'internal' resources. LP1 (EX) states, "This is much more difficult to use [referring to Library Resources] ... Google in that sense is much easier to use". More on usability issues is presented in the next section.

3.2.7 Recommendations, training and support

The choice of resources also depended on the training provided by the universities, academic staff recommendations and information included in the module handbook. Based on the interview responses, all three institutions provide basic information skills training and library support to students and staff.

Participants also found out about useful resources from their peers during their group work. It was not common practice to seek help from a librarian when searching for information. Many had never met their subject librarian nor were they aware that the library provides subject support in finding information.

3.3 Electronic resource discovery systems: difficulties and challenges

When using library-subscribed resources, participants experienced a variety of problems, which relate to different issues: usability, difficulties in finding and accessing the resources, difficulties dealing with multiple paradigms and interfaces across systems, poor understanding of the content of resources, poor understanding of database structures, and how their searching mechanisms work.

3.3.1 Usability issues

Although library resources provide specialised material of a high quality they are often found to be too difficult and complex to use; they are not user friendly and they require specialist knowledge. Moreover, they are often difficult to find and access.

3.3.1.1 Difficulties in finding and accessing the resources

This study shows that participants want quick, easy and unproblematic access to and download of resources. However, the data shows that participants experienced difficulties finding and re-finding required resources. For instance: some participants when looking for EBSCO database followed the logical approach of accessing the letter 'E' within library resources. Unfortunately, they failed to find the link as it was displayed under the letter 'B' for 'Business Source Complete' being a part of EBSCO's database. One of the solutions to avoid this problem suggested by participants involved creating a set of Bookmarks of favorite resources allowing them to be accessed directly.

Another problem was that in order to locate desired articles, the user often has to search across several databases that have different operating procedures. In addition, database searches can often be unproductive because, for example, the full text is not available as anticipated or has been embargoed. There is a gulf between what the user expects the system to be capable of, and what the ERDS is capable of supporting.

Looking at the library catalogue and browsing books was often seen as too time consuming. Users got easily exasperated if the results took them down the wrong path; CP10 (EX) became annoyed when an article

that should have been on the topic turns out to have only a few words that relate to his keywords. He uses the expressions, "irritates me", "it wasted my time" and "I don't like it". In a number of cases, participants expressed annoyance, frustration and surprise when there were no relevant results yielded after a search on a subscribed database.

Participants commented on the various limitations of the systems. One of these relates to the availability of requested documents. Surprisingly, even when a document was not available, the systems suggested otherwise on many occasions. Users were annoyed when a promise of a link to a full-text article (references found via federated search engines and Google Scholar) did not result in the article(s) being available and required a further step in the process of accessing materials. This often resulted in abandoning a resource.

The federated search engine promises to incorporate accurate information on where a title is available as full-text and where it is only a reference. However, users are expected to click to find a full-text, only to be informed that the article is not available in the library and that they need to request it through inter-library loan. Users abandon searching on 'internal' resources when this occurs too frequently and turn to freely available resources on the Internet. This kind of situation raised expectations and often upset and irritated participants as they wasted time without obtaining the required document. A clear division of which resources are available as full-text and which ones are references to articles on the screen at the outset would increase user satisfaction immediately.

Students reported that they do not have enough time when working on academic assignments - hence their choice of resources. The perception of participants was that finding information on Google is quick – and speed appears to be a greater priority than quality of result. MP1 (PG) states that he finds material on Google Scholar because it's quicker and more efficient than the information databases and then he logs into the databases to download the articles he has found on Scholar. The searching capabilities on Google are much more efficient, in the words of another participant, "Google has come along and revolutionalised the whole search concept . . . Google is more dependable . . . than anyone else" (MP12, EX).

3.3.1.2 Difficulties: general issues

Participants were also dissapointed that library ERDSs (such as EBSCO and ProQuest) do not have a spelling correction feature. Having experience of using Google, where the system provides its users with alternative options, participants expected the same. Figure 1 below, displays the system's message received after a spelling mistake was made. The user ignored the message and persued with evaluation of the results. However, after discovering that the results were irrelevant, participants abandon the resource and opened a new resource for further queries. This illustrates the lack of understanding of how EBSCO deals with spelling mistakes and what actions can be taken in order to progress in seeking information.

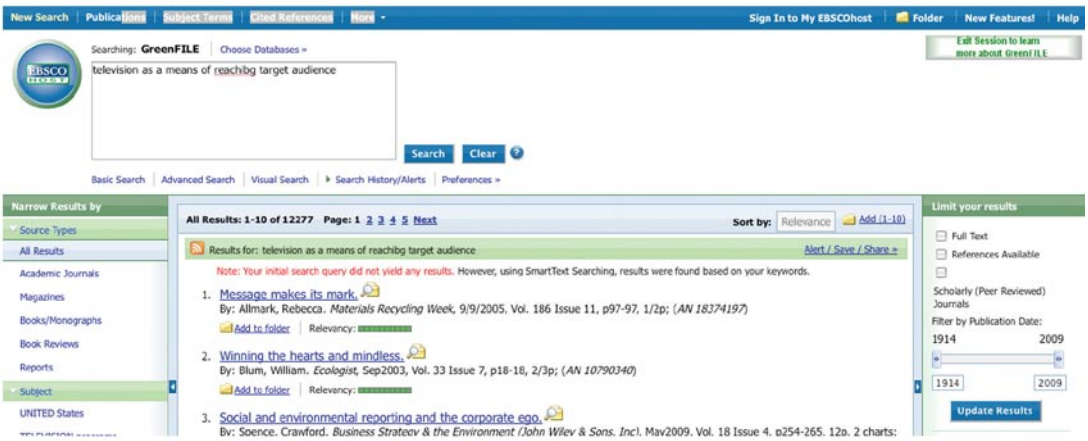

Figure 1. Spelling mistake in EBSCO (CP3, PG)

ProQuest presented another problem for the participants: the 'Time out' problem. Participants did not expect the system to time out without giving any warning. It created problems because all the searches performed were lost and there was no record of them after re-logging onto the system. This was especially irritating when participants had been working on the system for a while and had created many searches that were lost when the system 'Timed out'.

3.3.2 Difficulties dealing with multiple paradigms and interfaces across systems

Users found it confusing as the electronic resources are accessed through a multitude of different systems that in some cases appear similar, but actually operate differently. Also, sometimes a particular resource (e.g. a journal) can be accessed through multiple access points (with and without Athens authentication) and therefore have different access rights, different access structures, different user interfaces - based on different assumptions. MP12 (EX) describes the academic resources provided by the library as being 'professional' for 'professionals' whereas freely available web resources are for everyone to use including the novice user. CP1 (EX): "...all the resources ...for data are a bit more difficult and change quite a bit ...when you look for data it is not that easy so you have to learn and ask.".

The data show that navigating from one system to another – all of which have different functionalities with respect to searching, limiting/refining, indexing, saving and storage or exportation - is confusing for all users. Users literally have to 're-frame' their minds when they move from one system to another, and this requires patience, persistence and is time consuming.

Often search features appeared to be too complex and did not help inexperienced users to formulate their searches and select appropriate options in order to narrow the search results and obtain relavent documents. Very often, participants just put the search terms in the first box provided without specifying the field within which the search should be carried out. For example, MP7 types the following terms in the Google Scholar: "pepsi product placement in movies television".

Much of the confusion is due in part to the lack of transferability of learning between systems, and the apparent similarities between them that underlie significant differences. At the moment, users need to know when they are in a particular 'mode' so that they can apply those rules and assumptions that govern operation of the system under that mode.

3.3.3 Poor understanding of the content of resources

Many participants were unclear about what resources were available and/or which resources were appropriate for their immediate needs: "I don't always know which is the most appropriate [database]" (CP2, EX). They were also uncertain on how to access these resources, how to collect keywords, create a search strategy and search effectively and efficiently. Additionally, many did not have an understanding of the difference between library-subscribed resources and the Internet. Their only gauge was the ease of use and the perceived efficiencies of using Google to search on the Internet. Further, users were unaware of the scope of their own institutions' library collections ("cinema would not be at the LSE for sure" (LP2, UG)).

3.3.4 Poor understanding of database structures and how their search mechanisms work

Most users have transferred their understanding of information search and retrieval from search engines like Google to databases. While similar, both Google and databases allow you to find and retrieve information about articles, Google users do not need to have an understanding of how data is stored on the Internet. In contrast, formulating database searches is enhanced if users have some knowledge of the principles of relational databases, data tables and tuples (records in relational databases), i.e. the structures in which most bibliographic databases store their records.

Another difference mentioned earlier is that the specific operating procedures for accessing records in different databases are different. Users have to learn the procedural knowledge for using a particular database, which obviously has limited transferability. Their familiarity with search engines which are more forgiving and have much fewer rules, allow them to find information at a semantic level. With databases, they need to know the procedure, as well as have some basic idea of how the data table is organised, and to

what subject matter the built-in thesauri refers (e.g. a database on marine biology would probably not have an index term "marine biology"!).

The number of search field options provided by ProQuest, for example, raised further problems. For example, ProQuest is limited to only six rows (Figure 2). This limits a user's search ability and extends the time spent searching for individual search terms. CP4 (EX):' I don't know why you can't ... they might have changed the functionality. ... Because I haven't got as many rows to add as I would like ... I normally do everything at once in one job ... this is really irritating. I'm abandoning this because it's too frustrating.'

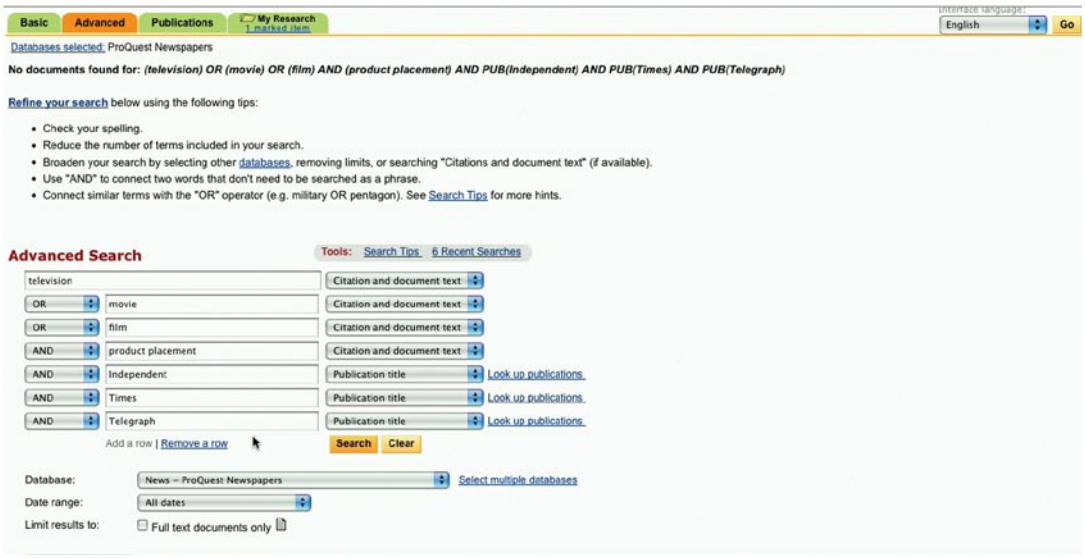

Figure 2. ix rows in ProQuest's 'Advanced Search' (CP4, EX)

Participants of this study had also experienced difficulties at the level of search. They were not sure about the categories by which the search terms were classified. Consequently, this caused the user to abandon the search and move to an 'external' resource. I'm not sure which category to use" (LP5 (UG) when searching for 'film tourism' (Figure 3)).

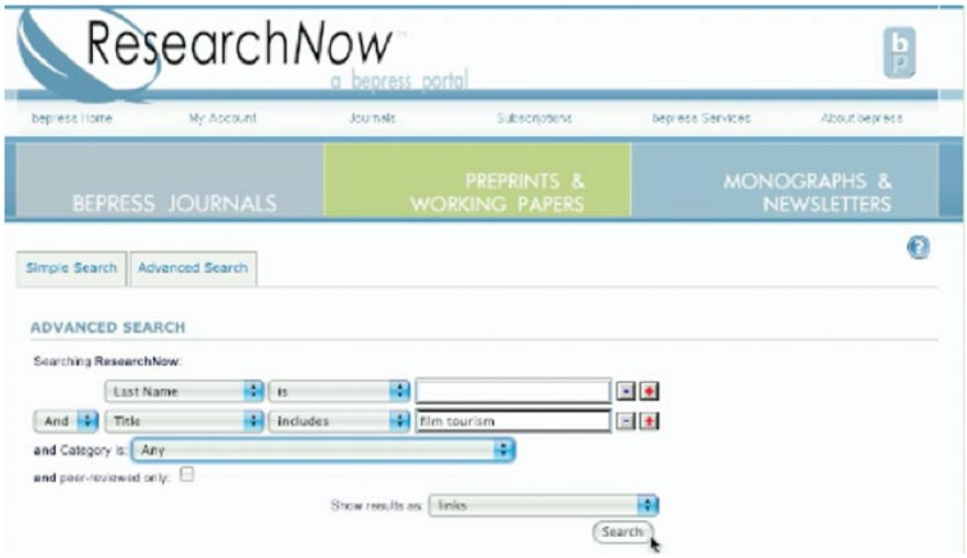

Figure 3. Complex interface of that requires selecting various options

Too many options are putting users off and making searching appear overly complicated in the initial stages of a search process. CP10 (EX), "Here is EBSCO. I don't like it very much. It's a little complicated to use. What is this 'EBSCO host Research Databases' and 'Business Searching Interface'? ... give me a simple interface . . . select all of these. Why do I have to select all of these. And where do I search?". It is in these instances, users turned to the librarian to ask for help.

CP2 (UG) "[Journal Citation Index'] has the worst searching capability ever. It doesn't do the nearest match [i.e. smart text searching]. You need the exact title and it isn't easy to find that either..." (Figure 4).

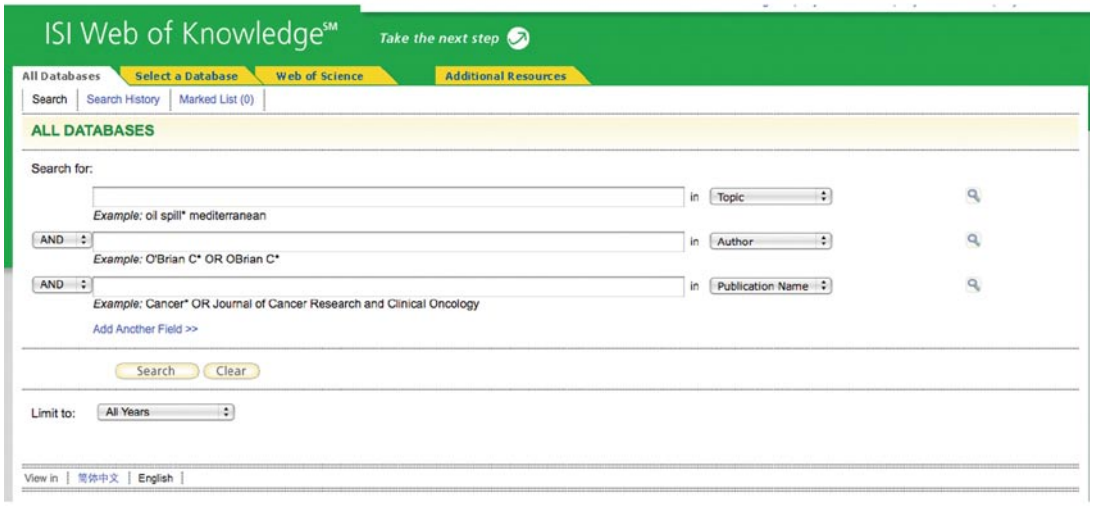

Figure 4. ISI Web of Knowledge

From the above, it is obvious that in order to use library-subscribed resources, one requires not only the knowledge of how they can be found and accessed, but also how the search mechanisms work and a subject/domain knowledge that allows searching within the correct category that is recognised by the system.

4. Discussion and conclusions

The study shows that although the library-subscribed resources are perceived by the users as resources consisting of high quality materials they are less frequently used than free Internet resources such as Google, Google Scholar or Wikipedia. Users prefer to use these resources as they are easier and quicker to use and, most importantly, they always return results whereas library-subscribed resources are difficult and complex to use, have poor usability and they lack integration between many resources. The lack of consistency in structure and integration implies that there is much greater dependence on procedural knowledge, which limits transferability of skills. Moreover, in order to use them effectively, users require training and specialist knowledge of the subject. All of these hinder users' information search and retrieval activities and distracts them from making sense of material they have discovered. People expect library resources to work in the same way as those available on the Internet, that is, simple and user friendly. Unless changes are made within library-subscribed ERDSs, users will continue utilising the Internet resources missing the opportunity of accessing a high quality scholarly materials.

Based on the study findings we have suggested a number of recommendations that deal with the lack of information skills that students demonstrated when using library resources as well as difficulties and challenges that users faced during the interaction with those resources. These recommendations relate to the three areas and are summarised as follows:

4.1 Information skills training

It is clear from observing the behaviour of students during the course of this research that there is a major need for a strategic approach to information skills training. Many users, predominantly undergraduates and graduates, were unclear about what resources were available and/or which resources were appropriate for their immediate needs, how to find and access these resources, how to create a search strategy and search effectively and efficiently. Our recommendations here fall in two related areas:

(i) Digital (IT) literacy. Students are generally digitally literate and most are quite capable of navigating interfaces to complex technologies, e.g. Facebook. ERDS user interfaces should focus on designs that make it easier for users to find information. This is not just about better usability, but about understanding what information is relevant to the resource discovery process, and making readily available that information and guidance which shows why a resource or database could be useful.

(ii) Information literacy. Information literacy sessions should be an integral aspect of the students' academic programme of study, developing the necessary information skills in relation to a particular subject matter. It should not be something that happens only during 'induction week'.

4.2 Usability and effectiveness of electronic resource discovery systems

As participants experienced a lot of irritation and frustration when trying to use the resources, as their structure, scope and the way they operate varied across different resources. There is a need for greater consistency in interactions across different platforms to ensure resources is required. Our recommendations include:

(i) *Adopt common techniques for manipulating user interfaces to create a more consistent user experience, so that techniques learnt in one resource system can be applied across the different resource systems.* Navigating from one system to another – all of which have different functionalities and different bells and whistles with respect to searching, limiting/refining, indexing, saving and storage or exportation - is confusing for all users. Users literally have to 're-frame' their minds when they move from one system to another and this requires patience, persistence and is time consuming. If this issue is not dealt with, it is likely to alienate present and future users from accessing academic e-resources.

(ii) *Simplify the Search Interfaces.* Too many options are putting users off and making searching appear overly complicated, especially in the initial stages of the search process. Often search features are too complex and do not help inexperienced users formulate their searches and select appropriate options in order to narrow the search results and obtain relevant documents. In comparison, Google, Google Scholar or Wikipedia's simple search requires very little learning effort to access very powerful search engines. The interfaces are clean and attractive. They are not cluttered and because of the limited choices of what can be done, users can operate the interface intuitively. In addition, advanced users can still easily access more powerful features.

(iii) *Address the 'time out' issue.* The 'time out' created problems because users invested time and effort and the investment was lost. All the searches performed were lost and there was no record of them after re-logging onto the system. This was especially irritating when participants had been working on the system for a while and had created many searches that were lost when the system 'Timed out'.

(iv) *Include spelling auto suggestions when searching.* Auto-suggestion ensures that users are prompted with the correct spelling when a keyword is typed incorrectly, and reduces the problem where some databases only provide exact word matches. This increases the user friendliness of a system and the perception that the system is helpful.

(v) *Improve facilities to support dynamic searches, and the retrieval and re-access process.* We recommend that electronic resource discovery systems (a) need to be flexible to enable users to move between different resources, and to then return later and continue a previous search. We call this continuity across different search modalities; (b) accommodate the various combinations of search activities, rather than just static or rigid pathways, recognising that search activities occur in various combinations, rather than in pre-defined sequences; and (c) enable easy transition between 'internal' resources (library catalogues, EBSCO, Science Direct), and 'external' resources (the Internet, Google, Google Scholar, YouTube).

(vi) *Make users aware of changes to database functionality*. Publishers need to make it clear that database functionalities have changed so that users are aware of these changes. Users who have not logged on for a while do not like unexpected changes and express irritation and surprise.

(vii) *Provide a built-in dictionary or encyclopedia.* Given that most users begin by gaining an understanding of their subject by looking on Wikipedia, it would seem that concept/subject/keyword definitions would be a useful feature to have built into the database – and these must come from a quality, trusted source, preferably one that is subject specific.

(viii) *Avoid confusion caused by multiple usernames and passwords.* Many participants did not have separate Athens usernames and passwords, and were confused when asked to type in their Athens username and password to access the resources. Some participants abandoned the use of library e-resources altogether when prompted to authenticate as they did not have or remember their username and password.

4.3 Poor understanding of the concept, scope and way the resources operate

As users are not always aware of what information is available, contained, organised or stored the need for making the underlying database structure visible is of paramount importance. The important issues here is that the current systems need to be designed in such a way that users can understand them, find their way around, and find required information following clearly visible routes and access paths. In summary, the systems need to: (i) have the underlying structure visible, and (ii) provide road-signs in virtual information spaces allowing the smooth navigation through those systems.

The suggestions for recommendations presented in this paper might be a starting point to changes require in curriculum and in the design of 'new generation' ERDSs that will facilitate for different users ranging from a novice who is often unsure of the way that the system is structured and works, to an expert who requires a more advanced way of information seeking.

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Shifting themes, shifting roles: the development of research blogs

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The study described in this paper investigated the use of research blogs by postgraduate students over a four-year period. An initial, one-year, pilot focused on the research blogs of three first-year doctoral students (Ferguson, Clough, & Hosein, 2007). Analysis indicated that blogs were used to promote a community where students were encouraged to reflect and share ideas, skills and stories of research life. The blogs also acted as memory repositories and encouraged collaboration. The main study followed the students' blogs for another three years, as they completed their doctorates and took jobs as early-career researchers. It investigated changes in the use and content of research blogs during this period. All three students continued to make use of their blogs for reflection over this period, and the blogs' use as a memory repository became increasingly important, especially during the period of writing up research. Once the students had made the transition to early-career researcher, the nature of their blog use changed and began to fragment. This was due, in part, to issues of confidentiality, and data protection associated with their employment. While they continued to use their original research blogs to promote community and collaboration, the constraints of their work meant that new posts were often posted in closed blogs, or were marked as protected. At the same time, they were required or encouraged to make use of project-related blogs as part of a planned communication strategy by their employers. The findings of this longitudinal study clarify the changing expectations and needs of learners, employers and society in relation to researchers' blogs, and identify skills, awareness and knowledge needed to support the use of blogging by research students.

Keywords: *changing environments, changing tools, professional development research, responding to change, collaboration, CPD, learner voice, open content, peer support, social networking Web 2.0*

1. Introduction

Learning is fundamentally social in nature, with knowledge co-constructed by learners whose understandings are mediated by meaning-making tools such as language (Vygotsky, 1987, 1997). This sociocultural view of education emphasizes the importance of learners' social and temporal settings and of the tools they employ (Wells & Claxton, 2002). It therefore views 'usage of a specialist discourse and membership of a specialist discourse community' (Northedge, 2002, p52) as key goals for a student.

During the past decade, this discourse has increasingly involved the use of blogs. These frequently updated websites consist of short posts, usually personal, with commentary and links (Mortensen & Walker, 2002). At undergraduate level, blogs have been integrated into assessment, and used to develop critical engagement and reflection on course material (Burgess, 2006). At postgraduate level and beyond, doctoral students have begun to use research blogs in place of research journals (Ferguson, et al., 2007; Walker, 2006). At a professional level, scholars are using blogs as spaces in which to develop the social networks that support research (Halavais, 2006).

A related shift in practice, stemming from the participatory, collaborative and distributed potential of Web 2.0 technologies including blogs, has resulted in the emergence of 'edupunk' – a learner-centred, community-created, progressive and relevant approach to education (for a summary of significant edupunk blog posts, see (Madsen Brooks, 2008)). Blogging, and its associated literacies, are increasingly important aspects of academic and scholarly practice and academic bloggers can be viewed as a community of practice (Wenger, 1998). In such communities, different levels of expertise are present simultaneously, there is a fluid progression from novice to expert and the community engages in completely authentic tasks and progression. However, the collaborative, participatory and distributed aspects of blogging imply

a community of practice that is very different from the traditional academic community with its emphasis on individual possessive intelligence, individuated authorship, stability and fixity (Walker, 2006). Indeed with the introduction of new social networking tools such as Facebook, MySpace and micro-blogging tools such Twitter alongside blogs, the collaboration practices within the community of practice is dynamic. The research set out in this paper investigates this dynamic evolution of new budding academic researchers (PhD students) as they transitioned into independent academic researchers (early-career) and how their blogging activities and related social networking activities over this period have helped (or not) them engage with their academic communities.

2. Background

The asynchronous environments of blogs offer opportunities to construct personal meaning alongside written text (Lapadat, 2002), time to make considered contributions (Hawkes, 2001) and opportunities for both reflection and critique (Conole & Dyke, 2004). These factors are significant affordances of academic blogs and illustrate the perceived and actual properties that determine their possible utility (Gibson, 1986). Viewed in these terms, blogs are an online extension of traditional scholarly activities, with hyperlinks and blogrolls taking the place of bibliographies, keywords replacing indexes and comments sometimes functioning as peer review. Reading and writing academic blogs thus require digital literacies, 'the myriad social practices and conceptions of engaging in meaning making mediated by texts that are produced, received, distributed, exchanged etc, via digital codification' (Lankshear & Knobel, 2008, p4). More radically, the participatory, collaborative and distributed affordances of blogs offer the possibility that knowledge construction within the 'blogosphere' could involve entirely new practices.

> *The more a literacy practice privileges participation over publishing, distributed expertise over centralized expertise, collective intelligence over individual possessive intelligence, collaboration over individuated authorship, dispersion over scarcity, sharing over ownership, experimentation over "normalization," innovation and evolution over stability and fixity, creative-innovative rule breaking over generic purity and policing, relationship over information broadcast, and so on, the more we should regard it as a "new" literacy (Knobel & Lankshear, 2007, p21).*

Thus computer literacy can be characterized as a digital literacy – the ability to use specific tools, in this case hardware and software applications – for instrumental purposes. Critical technological literacy is new in that it is associated with a deep knowledge of the affordances and possibilities of those tools, and creative literacies are associated with a willingness to experiment with technology in order to create and manipulate new forms of content. Network literacies include 'the ability and the impulse to effectively and ethically manipulate a range of technologies to communicate and collaboratively construct and share knowledge' (Burgess, 2006, p107). These emergent literacies require a shift in practice towards intellectual and creative autonomy, as well as a willingness to engage with unstable, contested genres (Burgess, 2006). It is not yet clear whether academic blogging supports the development of academic communities of practice or whether the tensions between blogging and academia limit the possibilities for digital scholarship. It is also not clear whether academic bloggers are developing and employing new literacies rather than reworking traditional literacies in a new setting.

3. Method

In order to investigate the practices of academic bloggers, a four-year study of three such bloggers was carried out as they worked on and completed their doctoral studies into areas of educational technology and began work as early-career researchers. In the first year of their PhD, these three bloggers – Author A, Author B and Author C had three individual research blogs and a community blog. The blogs were set up as an online research journal to assist these new researchers on their journey. Two of the authors had moved from industry to start their PhDs as a late career change whilst the other author had changed from a budding engineering academic career. Author A's research investigated learning in online communities, Author B's research was on mobile technologies and informal learning whilst Author C looked at students'

mathematical understanding with software. Author C's blog and the community blog were open blogs in that anyone could have accessed them but Author A and B's blogs were dark blogs in that they were private and only approved readers could access them. The initial findings from their first year of blogging during their PhD are reported in Ferguson et al (2007). The longitudinal aspect of this research provided an opportunity for exploring in what ways a changing community of practice influenced how the researchers used their blogs.

The community blog ended at the end of the first year but all three continued with their research blogs. Authors A and B started a new open collaborative blog with the intention of sharing information on research activities around the university and they also opened their research blogs, whilst Author C started another open blog with the intention of sharing research tips with new postgraduate students. At the end of the PhD, when all three started academic research jobs (in educational technology), Author A found herself creating two blogs for her work. One blog was her official work blog and it was open in that it was outward facing to the internet audience and the intention of the blog was to act as a public relations outlet. Her second work blog was a dark blog where information on the project on which she was working was kept private. Author B found herself in a similar situation to Author A, and she also created a new dark work blog. The content of this blog related closely to the active work of her project and was intended to feed into the project evaluation activities. Author C continued using her research blog as her work blog but created private and password-entry posts for work-related posts that might contain sensitive information.

To analyse the eight current blogs (three research blogs, one collaborative blog, one additional blog and three work blogs), we used the 31 blogging posts categories that we identified in Ferguson et al (2007) based on a grounded theory approach. The categories were based on the purpose of the posts. The categories were also grouped into six overall themes (see Table 1). Each blog was analysed based on these 31 categories and were assessed on whether:

1. The blogs were still being used for the same purposes
2. If not, whether a new software or social networking application (Twitter, Facebook etc) was being used for the same purpose
3. When and why blogs were no longer used for a particular purpose

It was important to look at how the authors changed their usage of blogs as when they initially started blogging in 2005, new social networking technologies were not widely available. Technologies such as Facebook and Twitter did not become mainstream until during or after 2006.

Overall Themes	Description of Blogging Posts
Community	A high degree of interactivity and collaboration between the bloggers
Reflective	Discussion on research ideas, progress, methods, methodology, theoretical frameworks and academic writing
Environmental	Discussion on shared experiences of the research environment, or the physical environment to describing their immediate situation (noise, temperature, mood).
Memos	Organisational posts listing things to do and remember, and links and references to external material and websites
Emotive	Indication of how the author was feeling at the time, expressing such feelings as doubt, uncertainty or humour
Blogging-Related Posts	Discussion on blogging as an activity and as a tool for data analysis

Table 1. Overall identified themes of the blogging posts

The remainder of this paper summarises the findings from the main study, outlining how the blogging practices evolved and how these new practices measure up to the themes identified in the pilot study.

4. Contribution

4.1 Shifting roles within a community of practice

The changing roles of the authors as researchers were reflected in their blogging practice. This was associated with an awareness that their audience was changing and, with it, their reasons for blogging. As first-year doctoral students a concern had been to acquire readers; the pilot study found that some 'posts were designed to elicit expert help' and Author A was looking for ways to make it 'easier to sign up new readers'. By the third year of their doctoral study, they had set up additional blogs intended, at least in part, to pass on expertise. For example, Author C wrote 'This blog is intended to give tips or tricks etc. to any new researcher starting out. I am a PhD student so within the last 3 years I've done some stuff that I would like to share.' Author C's new blog contained resources for new researchers, including videos and hyperlinks relating to the use of software and research blogs.

Author A and Author B set up a jointly authored blog in order to interact with other academics and to pass on expertise. The first post in this blog was a link to the pilot study (Ferguson, et al., 2007). The second post was entitled RSS Feeds and read:

> *A few months back, I spent some time at http://zetoc.mimas.ac.uk/rssjnllist.html setting up RSS feeds for all the journals I receive Zetoc alerts for. A good feed contains a list of all the articles in the current issue . You can click to get authors, and then drill down to more information. Looking at my Netvibes page where I keep these feeds, I'm disappointed by the amount of journals, many of them focused on online technology, which aren't supplying materials to these feeds. Cyberpsychology and behaviour, International Journal of Web-based Communities, Learning and Instruction, ALT-J, Active Learning in Higher Education and Computers in Education all have no items in their RSS feed. I think they need to get on the case.*

This represents a shift from the fringes of academia to active participation within a community of practice. Both blogs take the view that they already have expertise to share with novices, and this expertise is related to their familiarity with and development of new and digital literacies. Both blogs are sites for the development and display of digital literacies. Moreover, the authors were confident enough to comment on, and even try to change, the practice of more experienced academics who possibly have less awareness of these literacies, or less time available in which to employ them.

Some of the themes that emerged in the pilot study appeared more rarely or were no longer evident by the end of the main study. The early blogs contained 'rants' that detailed the frustrations and brick walls the authors had faced. These rants had largely been transferred to become short outbursts in Twitter – but one author specified that she ranted in a dark blog, where other members of her team would not be able to see her comments. This was also where she chose to record her self-doubt and uncertainty, away from the eyes of her line manager and project team.

More negative, from the point of view of academic collaboration and participation, was a perceived need to hide the emergence of ideas, data analysis and reflection on the research process. These concerns had prompted Author A and Author B to set up dark blogs, accessible only to certain members of their project team, and had prompted Author C to password-protect many postings on her otherwise open blog. They agreed that noting the emergence of ideas is important. This corresponds with one of the main roles of the blog in that it acted as a repository for emergent ideas and reflections. The use of their blogs in this manner continued for the duration of the study for reflections relating to their post-doctoral work. However, unlike in their PhD blogs, these reflections were all kept in dark blogs. This was a significant shift away from their original openness and willingness to share both ideas and reflections, representing a move toward use of dark blogs for personal knowledge management, event logging and knowledge sharing within a limited work-related circle (Charman, 2006). They noted that this reticence had significant limitations – they had stopped commenting on each other's blogs because so many postings were hidden or inaccessible. They related this shift in practice to their role in the academic hierarchy – PhD research had been under their control, while funders, principal investigators and other team members controlled their work as early-career researchers. Another concern was the importance of their new projects, all of which were aiming to have long-term international impact that could be jeopardised by team members writing the wrong thing in the wrong place.

At the same time, there was a growing awareness of blogging as evidence of digital scholarship and of the need to become an established and significant contributor to the genre in order to progress within the academic hierarchy. One of the authors included her blogging activity within her curriculum vitae, and was required to write for the project blog as part of a planned communication strategy. She commented that this involved 'conscious effort' and a shift in style. For example, although she uses emoticons on Twitter and within her own research blog, she explained that she 'won't do it in the outward facing [project] blog because it is professional writing and requires a more formal style.'

4.2 Developing literacies

Running in parallel with changes in the authors' blogging that related to their role in an academic community of practice were shifts that related to their development of the associated new and digital literacies. First of these was their growing computer literacy – their increasing familiarity with the use of a variety of software and applications. As a result, significant amounts of blog content had been transferred to other sites – most of which did not exist, or were far less significant when the authors began their blogging. All three had moved their humorous comments and their references to their physical environment into the microblog Twitter. Communication about research questions, and communication with other academics had shifted to Cloudworks (Conole & Culver, 2009) – a site for sharing, finding and discussing ideas. Pictures and links still appeared in blogs, but also in Facebook; collaboration increasingly involved Google Docs or Google Wave, and previously public notes and planning were stored privately on OneNote.

The reasons for these moves displayed increasing critical technical literacy, and a sophisticated understanding of the affordances of these different tools. All three authors were using Twitter streams from conferences, and hash tags, to stay in touch with current debate and discussion in their field, and to source relevant links, resources and ideas. When they had sourced these, they had a variety of choices when passing them on to others. Author C used to use her blog to share links, resources and ideas. However she now noted that when she wanted someone to comment on what she had written: 'If I put it on my blog no one will see it. Readership is larger on Facebook/Twitter and I can reach a targeted research audience'. Within her work team, they tend to use email for group communication, and although she uses social bookmarking applications such as Delicious and Google Bookmarks, she uses these for personal rather that work-group related links.

Author B still uses her open blogs to share references and links. However, she has moved to using Cloudworks as an important way of linking out to get input from the wider academic community. Cloudworks is a collaborative application that can in some ways act as a substitute for a blog. It is free to join and members can create clouds (that is web-pages) for ideas or issues for discussion. Others can then add to the cloud by contributing to the discussion (similar to comments on a blog), and adding links and academic references. Each cloud can belong to one or more Cloudscape (that is an overarching themed website) which groups related ideas together to make them easier to find. Author B is using Cloudworks heavily for work-related ideas and reflections that she would previously have posted in her open blog. She also uses a closed project wiki, but as this is only open to members of the project team, its potential for knowledge creation is more restricted. Like Author C, Author B uses Google Bookmarks extensively, relying on it to provide a consistent set of project-related links across a variety of devices (mobile, laptop, desktop). She also uses Google Wave for project-related collaborations, although these dialogues are not made public until they have been converted into a concrete form such as a conference proposal or journal paper. Author A still uses her blog for references, bookmarking them and adding them to a Tumblr microblog with related pictures and click-through links.

In this case, ten applications replaced a single blog. Subtle differences between the affordances of each determine when and how it is used. In most cases, the audience is critical – some media have large audiences, some (such as dark blogs) have no audience except the author, some are academic, some mainly social and some are collaborative, or offer fast responses, or are used by certain groups. This familiarity with a variety of applications supports creative literacies which allow the authors to make effective use of all these media, and a willingness to combine them where appropriate. Images can be used to illustrate points, to add clarity or for visual appeal. Videos can be created and embedded to add multimodal elements to an explanation. Blogs can be designed and tailored for different purposes and for different audiences – and the authors demonstrate a growing awareness of where those audiences can be found, how they

can be contacted and how they can be engaged, using networking literacies as they collaborate, share and participate online.

5. Evaluation

The study showed evidence of changing practices as the authors moved from a PhD student to an early-career academic researcher. As early-career researchers they joined a community of practice in which the sharing of expertise, peer review and participation in the academic community were valued, but were also controlled more closely by the project for which they worked. When their online collaborations were restricted to the team with which they worked (closed or limited audience blogs, email communication, project-specific Google Waves) this limited their use of the collaborative, participative and egalitarian affordances of blogging. Employment as academics thus constrained their ability to collaborate widely and openly as they had as students. Also, the move towards digital scholarship and the need for experienced members of the community of practice to demonstrate expertise and impact to an external community by aligning themselves with the UK's Research Excellence Framework (REF) is limiting options and formalizing practices which translates into the moving away from the aspirations of edupunk.

The relative importance of the themes identified by the pilot study; **Community, Reflective, Environmental, Memos, Emotive** and **Blogging-related,** has also changed during the early career stage. These themes remained relatively consistent during the doctoral process itself with the **Reflective** and **Memo** posts acting as memory repositories. These were crucial during the writing-up process, as the memory repositories were useful references when writing the methodology sections. Further, the **Reflective** posts also helped the researchers to gather their thoughts when writing their analysis and discussions. However, during the transition from doctoral to early-career researchers, the **Community** posts that showed a high degree of interactivity and collaboration moved into new technologies such as Twitter, Cloudworks and Facebook. **Reflective** posts discussing research ideas, progress, methods, methodology, theoretical frameworks and academic writing, together with **Memos** containing to-do lists and organisational aspects, continue to occur frequently in the early-career researcher blogs. However, the more creative **Reflective** posts are now placed in the dark, work-related blogs. The **Reflective** posts that were placed in public blogs, either the outward-facing work blog of Author A or the expertise-sharing blogs of all three authors, were either unrelated to work, or were carefully scrutinised to ensure that no confidential information was inadvertently released. **Environmental** and **Emotive** posts tended to crop up in Twitter and Facebook, and where they were blogged, they were blogged in dark blogs accessible only to the authors. **Blogging-related** posts occurred rarely.

Shifts in technology identified by this study also support a freer, more informal voice. The emergence of collaborative technologies such as Twitter and Cloudworks provides an alternative way to reach out to a wider audience and to engage in knowledge creation with an academic community who are not members of a project team. This development of technical, creative and networked literacies among the three authors in this study was driven, in part, by the collaborative constraints imposed by the need to keep some work-related information confidential. However, it is likely that student bloggers are also making use of these media to reach out and co-construct knowledge, and that student blogging practices have evolved to incorporate use of these new technologies. One must note that all of the three researchers were in educational technology and hence using technological tools to aid collaboration may have been easier for them than for other academic researchers.

6. Conclusion

This longitudinal study is valuable because it tracks shifts in blog usage driven by the pressures of the transition from student to early-career researcher. As educators, we are interested in how blogging can:

> *'contribute to a reconceptualization of students as critical, collaborative, and creative participants in the social construction of knowledge and [is] compatible with the social constructionist framework for learning, which - unlike the "transmission of knowledge" model - assumes that students must become active partners*

in the construction of knowledge with their peers, academic staff, and the wider social context of the disciplines in which they work.' Burgess (2006).

However, as our students enter the workplace, new skills and literacies are required by employers, and these may differ subtly from those we instill in our students. It appears that the values of traditional academic community with its emphasis on individual possessive intelligence, individuated authorship, stability and fixity (Walker, 2006) persist and to some extent, inhibit the collaborative, participatory and distributed aspects of blogging to which the early-career researchers had been accustomed to as student-bloggers.

Our recommendation for new postgraduate students still stands as when the first paper was written (Ferguson et al, 2007) in that blogs can support and extend learning and can continue to do so throughout their studies. However, the postgraduate blogs should not be stand-alone but should allow for integration with collaborative academic social networking tools such as Twitter or Cloudworks in order to encourage dissemination and wider feedback from academic peers. For early-career researchers, the affordances of blogs may be limited as the power over their research activities shifts during their transition from post-doctoral students, and their blogging activities come within the remit of their employer. The blog can continue to act as an early-career researcher's memory repository but the collaborative affordance of a blog may be lost unless all team members are on board.

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SWIFT-ly enhancing laboratory learning: genetics in the virtual world

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Undergraduate laboratory classes are constrained by time, resources and space, with limitations on the opportunities to acquire essential skills, such as, linking practical approaches with theoretical knowledge, team working, communication and development of experimental strategies.

The 3D Multi User Virtual Environment of Second Life® (SL) allows low-cost simulation of real-world spaces. As part of the SWIFT (Second World Immersive Future Teaching) project we have created a virtual genetics laboratory in SL to study the effectiveness of this medium for addressing limitations of practical laboratory classes. The aim is not to replace real laboratory teaching but to supplement it.

The first phase of the project was to develop an activity in SL to support real life laboratory induction. Thirteen Biological Sciences undergraduates volunteered, attending an SL training session and a taught class in the virtual lab with the aim of learning Health and Safety and the use of specific lab equipment.

The virtual lab classes ran successfully; the only technical difficulties encountered were with putting on and removing lab coats. The SL environment supported all activities well, except for detailed demonstrations of picking up and manipulating objects for which we suggest alternative approaches.

Participants were overwhelmingly positive about the virtual laboratory, finding it more realistic than expected. They reported a meaningful experience, but commented on the need for greater interaction with the virtual equipment. While learning gains were not directly measured, participants felt that they had either learnt new information or successfully revised existing knowledge.

Interactions between participants took place simultaneously in the physical room and in SL. This arrangement benefitted the SL socialisation process whereby participants gained a sense of reality and ability to work with others in the virtual environment.

Overall, we conclude that the virtual lab can provide both good preparation for the real lab and good revision afterwards. The virtual lab induction activity provides an excellent basis for subsequent phases of the SWIFT project.

Keywords: *3d worlds, collaboration, early announcement effectiveness, FE, genetics, immersive learning laboratory, learning, multi user virtual environment, MUVE productivity research risk, Second Life, undergraduate, Virtual Environment*

1. Background

Effective practical science learning involves acquisition of skills including:

1. Understanding of the laboratory environment, equipment and issues.
2. The ability to carry out pre-designed experiments and evaluate data from a variety of technologies and equipment.
3. Linking of practical skills with theoretical knowledge.
4. Development of higher-level skills involved in strategic experimental design.
5. Development of team working and communication skills.

In laboratory-based classes there are constraints of time, resources and space, and limited opportunities for interaction between students and teachers ; ;). Research using problem based experimental design tutorials shows that group work improves students' strategies for carrying out experiments but not factual knowledge, whereas students' skills improve when working together online. There is a need for a different approach, combining the advantages of laboratory, group and on-line working.

1.1 Real-world genetics laboratories

At the University of Leicester, first year undergraduate genetics laboratory classes involve a combination of classical and molecular genetics experiments related to a range of organisms including bacteria, fungi, fruit flies and humans. A typical laboratory holds approximately 120 students and contains standard tools and equipment, such as PCR (Polymerase Chain Reaction) thermocyclers (to amplify DNA samples), equipment to visualise DNA, microscopes, micropipettes (for transferring small quantities of liquid) and Bunsen burners.

In genetics laboratory work, it is important to avoid contamination of the samples and to work very precisely. Laboratory users must understand how to behave in a lab, the wearing of appropriate clothing and how to use equipment safely.

1.2 Virtual worlds

The use of 3D Multi User Virtual Environments, or virtual worlds, alongside real laboratory teaching is one innovative approach to improving student laboratory learning. Virtual worlds are interactive computer-based environments that can be accessed by many people simultaneously through the internet. Each participant in the virtual world is represented by an avatar, a human-looking representation of him or herself. Other participants also appear as avatars in the virtual world. Avatars can explore the 3D space together in real time. Avatars can, for example, walk around buildings, talk to each other and interact with machinery and other objects. The world is persistent, and continues to exist and change whether an individual avatar is present or not.

Virtual land may be landscaped and buildings and objects may be created. Avatars can engage in social activities or work together in-world; learning spaces may be created and classes held.

1.3 The SWIFT project

SWIFT (Second World Immersive Future Teaching) is a three-year research project at the University of Leicester funded by the Higher Education Academy through the National Teaching Fellowship Scheme (NTFS). SWIFT is lead by NTF Prof. Annette Cashmore with NTF Prof. Gilly Salmon. The pedagogical limitations of practical teaching outlined above are relevant to many areas of science teaching but SWIFT focuses on the teaching of genetics within the biomedical sciences.

SWIFT has created a virtual genetics laboratory (Figure 1), to design activities in the virtual world in order to address some of the limitations of teaching in real laboratories, to develop learning situations whereby the activities are used alongside other modes of practical teaching, and to assess the effectiveness of the use of virtual worlds in this way on the students' learning experience, providing exemplars for other sciences.

Many virtual worlds exist , with varying functionality and affordances. Second Life® (SL) was chosen for SWIFT because it is considered the most technically sophisticated and stable system available, and in use by other educational institutions . In addition, the University of Leicester's Beyond Distance Research Alliance (BDRA) has had a presence in SL since January 2007, in the form of its Media Zoo .

Figure 1. SWIFT virtual genetics laboratory (Rudman and Lavelle 2009)

In the SL laboratory students, as avatars, can explore, experiment and evaluate situations in a risk-free interactive way. Students can visit the laboratory in their own time, try out experiments unsupervised and take as long as they need, unlike a real laboratory which must be supervised for health and safety reasons.

In addition, since student interaction with the virtual laboratory is mediated by the computer, we are able to implement pedagogic models that are not practical in the real world. For example, virtual items of equipment can hand out usage notes, high-risk situations can be demonstrated and abstract concepts can be directly related to learners' actions.

SWIFT develops in stages to involve three types of activity:

i) Laboratory induction (pilot with first year Biological Sciences students).
ii) Investigation of case studies for genetic screening (first year medical students).
iii) Problem-solving, experimental design sessions in molecular genetics for trialling different experimental strategies, (second year Biological Sciences students).

We report here the first stage of SWIFT – induction into a genetics laboratory. In the real laboratory, students are given a printed sheet with relevant health and safety procedures; instructions on equipment use are given as and when required for each experiment. It is not cost- or time-efficient to use a real laboratory session solely for health and safety and equipment use issues.

The learning objectives for this part of SWIFT were identified as gaining an understanding of the laboratory dress code and health and safety in the laboratory, both generally and for specific items of equipment, as well as the basic operation of specific equipment.

This paper describes the process of preparing the virtual laboratory, preparing participants for the virtual world, and conducting virtual classes, along with our findings and observations.

1.4 Examples of other virtual world projects

The University of East London developed a virtual laboratory in SL that allowed students to use a PCR thermocycler .This experiment compared the learning gains of conducting an experiment in SL compared to watching a video of the experiment being conducted in a real laboratory.There was a high satisfaction

with the virtual world experience. Although the learning gains were found to be similar in both cases, it was concluded that conducting the virtual experiment "makes students better prepared for the real thing" . SWIFT will look for evidence of the virtual lab as preparation for real-life labs.

The University of Bedfordshire asked 84 undergraduates studying IT Project Management to build showcases using SL . Initially, no assistance was given to the students in using SL, on the grounds that it is software intended for public use and students on a computer-related degree should be able to learn its use. However, this proved "overoptimistic". It was found that a small introduction (15 minutes lecture time) greatly helped students begin building in SL. SWIFT will investigate ways to minimise time spent on SL training.

The University of Leicester's MOOSE project (MOdelling Of Second life Environments) investigated the socialisation aspects of using SL. A small number of part-time mature students were recruited from a distance learning course in Archaeological Theory. MOOSE used SL activities to help the students "explore the social structure and spaces in traditional cultures". In particular, the project looked at the way socialisation takes place through SL with reference to Salmon's 5-stage model of on-line collaborative learning , finding "positive feelings about the nature of immersive environments and experience in it" . SWIFT uses experience from MOOSE in designing SL activities, such as helping participants identify with their avatar by including appearance and clothes changing in the SL training session.

2. The SWIFT virtual genetics laboratory

2.1 SL strengths and weaknesses

Virtual worlds use computer-based technology originally developed for games, allowing virtual worlds to benefit from the immersive sense of reality achieved by games and thus many affordances of the real world. A virtual world is fundamentally different to a Virtual Learning Environment (VLE) or classroom in being a world of experience, both cognitive and emotional. It is also a world that can be shared, experienced, discussed, and changed in a collaborative way with others.

The virtual world experience facilitates:

- Learning in context – field trips, learning in specialist spaces such as laboratories, experiencing an environment distant in time, space or accessibility.
- Learning procedural skills – a sequence of tasks, especially where tasks are spread out in space, or would take a long period of time, for example, doing lengthy laboratory work.
- Group-based learning – especially where learners are not able to be together in the real world, or cannot visit specific places together.

With game technology, and therefore with virtual worlds, one has limited control over details of an avatar's movement. Therefore, today's virtual worlds are not well suited to:

- Learning detailed practical tasks, such as manipulating objects.

2.2 Creating the virtual genetics laboratory

Based upon an analysis of the real labs at the University of Leicester, critical requirements for the SWIFT virtual lab were identified, such as protective clothing, safety notices, sinks and lab equipment. A number of objects needed to exhibit behaviours, for which SL scripts were written. For example, warnings are given when entering the lab without wearing a lab coat, alcohol catches fire when close to the Bunsen burner and avatars may pour liquid down the sink.

The SWIFT virtual lab was built inside a large dome-shaped building that already existed on the virtual land of the University's Media Zoo Island. The lab was built in-house based upon the functional requirements. The more specialised task of scripting (to make objects perform actions) was outsourced.

3. Method

3.1 Participants

All 180 students from first year Biological Sciences were invited to a presentation on SWIFT. 46 attended, of whom 19 volunteered and 13 students ultimately took part – nine female and four male, all aged under 25. Eleven participants reported that they already knew at least one other participant by the first SL session and seven classed at least one of those as a friend. Participation involved a one hour SL training session and a one hour SL laboratory induction.

A paper questionnaire given before the first SL session to all Biological Sciences students indicates that the self-selected sample is representative of the cohort in use of computer games and SL (Figure 2).

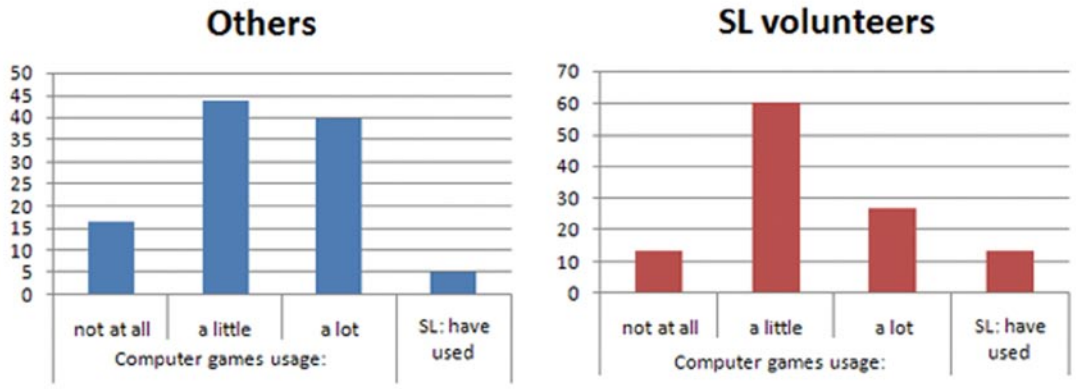

Figure 2. Comparison of computer game and SL use between SWIFT volunteers and non-volunteers (shown as percentages). Sample sizes 119 and 15.

3.2 Equipment

As SL is not yet available across the University of Leicester campus, laptops meeting Linden Labs' minimum requirements were set up using a private broadband connection.

Laptops were setup ready for each session, one for each participant. Version one of the SL software was used ("Viewer one"). Voice was enabled (to hear the Teaching Fellow – participants used text chat) and the start location was set to the University of Leicester island.

3.3 SL training

Volunteers were asked to register on the SL website to save time during the group session and because of Linden Labs' restriction on registering multiple avatars from one broadband line. Participants were not asked or encouraged to use SL itself outside the group sessions.

SWIFT provided a SL training session for participants as research suggests SL training is important for participants to use SL successfully . The SL training session took place on a simple platform in the sky above the Media Zoo (Figure 3), with a small breakout room out of sight of the main platform giving separate areas for male and female avatar changing.

For the SL training session, the Teaching Fellow and participants (from three to six students) sat together in one room. The Teaching Fellow assisted participants directly, and was also present as an avatar to help in-world. The Researcher Associate was present only as an avatar to conduct the training. SL abilities necessary for the main lab class were taught: chat, walking, sitting, defining and returning to a home location, joining a group, changing clothes, moving the camera (viewpoint on-screen) and capturing an image. Flying was also covered as this was considered intrinsic to the virtual world experience.

Figure 3. SWIFT SL Training Session

3.4 Virtual laboratory lesson

For the virtual laboratory lesson the Research Associate and the participants sat together in one room. The Research Associate's role was to assist participants in using SL if necessary and to observe. The Teaching Fellow was in a separate room.

In SL participants and the Teaching Fellow, as avatars, congregated in a social area comprising chairs and drinks machines. Firstly, the Teaching Fellow showed the participants around the virtual genetics laboratory (Figure 4) describing the main items of equipment, health and safety issues in general and such issues specific to each item of equipment.

Figure 4. Avatars in the SWIFT Virtual Laboratory Class

Next, in groups of two or three, participants completed a worksheet. The worksheet was provided on paper in real life, but participants worked together as avatars in SL to complete their worksheets, communicating using group text chat. The work required participants' avatars to take photos of three lab objects and place them on an in-world notice board, answer 11 health and safety questions and collect all the in-world equipment notecards. (Notecards contain text that may be stored and reread; they were available for each piece of lab equipment by clicking on an adjacent label).

Finally, the Teaching Fellow led a discussion about the worksheet exercise in SL with all participants. The Teaching Fellow communicated using Voice within SL while participants used text chat.

3.5 The research study

All 180 students in the cohort (including SWIFT participants) were given a paper questionnaire to ascertain attitudes towards laboratory work, both before and after the SL sessions. SWIFT participants completed a short online questionnaire after each SL session about their experience, and returned for a 30 minute interview about three weeks later. Interviews began with 10 minutes of questions about their experience and views of the SL sessions. A further 20 minutes was spent investigating participants' views on learning in second or real life, which will be reported elsewhere.

4. Results

4.1 Students' experience of the SL training

Participants encountered three main types of technical difficulties during the SL training: understanding the SL user interface, disorientation when flying or teleporting, and difficulty putting on and removing clothing.

Eight of the 13 participants had used SL at least once before the SL training session (two of which had used SL several times). These eight participants reported not seeking help in learning SL, with the exception of one person who used YouTube.

In a questionnaire after the session, all 11 respondents agreed completely or somewhat with the statement "I enjoyed the session". Only two of the 11 agreed with the statement "I didn't need the [SL training] session". Six of the 11 respondents agreed with the statement "I would have liked a second [SL training] session", four neither agreed nor disagreed, and one disagreed.

However, when the respondents' rated their skills for walking, flying, sitting, changing clothes, moving the camera and taking photos almost all of the 11 respondents' six ratings were "Very confident" or "Fairly confident" (58/66 ratings) with no "Not confident" ratings.

4.2 Students' experience of the virtual laboratory

The virtual lab classes ran successfully. The only technical difficulties encountered were with putting on and removing lab coats. Participants' views on the virtual laboratory were overwhelmingly positive:

> *"It's a lot more realistic than you'd imagine" (Participant-2a)*
>
> *"Its really clean and very expensive looking" (Participant-4c)*
>
> *"Cool! Really realistic and representative of a real lab in the university!" (Participant-4b)*
>
> *"It looked very realistic; I didn't think it would be quite that realistic, to be honest" (Participant-6b)*

From observing participants in both the physical room and the virtual lab, and from later interviews, it is clear that all of them had fun taking part. In particular, all 13 participants returned for the second session and again for the interview, with several asking for further sessions in SL or volunteering to act as advocates for the next phase of SWIFT by giving video interviews.

> *"It was just like playing a video game, like the SIMs or something ... I do feel comfortable in it [SL]" (Participant-4d)*

Overall, participants felt that they had a meaningful experience:

> *"Second Life gave me the opportunity to actually engage with what I'd be looking at. I know it's not the real experience, but you still get that, sort of like a taste, you kind of get a general idea of what's going to happen"(Participant-4e)*

When asked what they would change, the general theme was for greater interaction with the virtual equipment:

> *"If possible, next time we could do an actually experiment?" (Participant-4b)*
>
> *"I was hoping to use some of the equipment i had never actually used before but all we did was look at most of them" (Participant-6a)*

We did not ask or encourage participants to use SL outside of the two taught sessions. However, by the first taught session, eight participants had already used SL. One participant found that the virtual world, like the real one, offers a great variety of experiences when outside the University's defined area:

> *"When I did it at home and it didn't have that sort of filter on it was a bit unusual because, obviously, there was, you know, inappropriate sort of content when I went to the welcome area when I tried it at home. But in the contained area it was really good." (Participant-6b)*

In addition, the reason given by one of the original volunteers for choosing not to participate was that they went into SL (presumably outside the University's area) and did not like "the feel of it".

4.3 Learning in the virtual laboratory

Later phases of SWIFT will assess learning gains through virtual lab use. For the pilot, participants were asked to assess their learning experience. Overall, this gave a positive response

> *"The uses of the equipment, like a lot of the equipment we haven't actually been introduced to in real labs yet because we haven't needed to use them, so I think learning about the equipment was important." (Participant-4d)*
>
> *"There were a lot of things, like distilled water taps, that I'd never heard of before ... more like a professional lab." (Participant-4f)*

In addition, the session was also a useful revision aid:

> *"And safety rules I think, that she ran over, which we do normally go over in labs, but I felt like I was learning it more." (Participant-4d)*
>
> *"For me I think it's a better thing to have it now after I've already been to the real lab so I can connect it and see what I've missed" (Participant-5a)*

If these virtual lab sessions were to be used as part of the curriculum, it would be worth considering the views of three participants who suggested running the SL induction on arrival at the University:

> *"When I first started labs in September I was really scared of going into the labs cause we did no [lab] work in biology in A-level ... and if we had of had this induction it would have really helped" (Participant-4f)*

4.4 Tutor's experience

The tutor reported that students took the taught lab session seriously and behaved well, making it an easy class to teach. There were a few instances of sitting on equipment, standing on benches, flying and so forth, but offenders would desist when asked. It seems likely that this was due to the novelty and affordances of the environment, rather than intentions to disrupt the lesson.

5. Discussion

5.1 SL session

We were impressed at how quickly and easily participants learned to use SL. Based on MOOSE , we intended teaching SL skills, whereas it was clear that around half of our participants had already used and learned SL successfully at home. Although participants were self-selecting, their computer games and SL use seems similar to the rest of the cohort. It is possible that undergraduates generally are now sufficiently familiar with game-style software to greatly reduce SL training needs in future projects.

Although one command was available for avatars to return to the training area if they became lost when flying or teleporting, several avatars left the training area and needed significant help to return. It is possible that the experience of being lost was interesting and the person did not wish to hurriedly return. We will investigate this further in the next phase of SWIFT.

We gave the avatars a clothes-changing task as wearing and removal of lab coats is necessary in the virtual lab, and to help users gain some identification with the avatar. We segregated avatars by gender for this task as one would in the real world. Despite the training, many participants had difficulty later putting on and removing the lab coat, with three avatars left wearing a lab coat but with hair or other clothes. However, we anticipate that recent releases of the SL software (known as "Viewer 2") may address this (using improvements in how collections of clothing known as Outfits are handled).

In the virtual lab, there were scripted items which allowed the students to perform simple tasks such as pouring liquid down the sink. This proved less than simple for participants as the tasks involved several steps (take object, attach object, start animation, remove object), making the activity in SL far more complex than in real life.

As described earlier, the virtual world is not suited to learning detailed practical tasks, such as manipulating objects. The problems encountered here are further evidence of this weakness. Other similar projects have used the "click to see the bottle pour itself" approach, rather than showing the avatar holding the bottle and pouring. This is an important design consideration for learning spaces in virtual worlds which we shall take into account of in the next phase of SWIFT.

5.2 Lab session

Participants clearly believed that they had had a learning experience, either new learning, revision or both. Most participants believed that they had learned some useful health and safety information.

We were particularly interested in one participant's comment that (s)he had not used a laboratory before arriving at University. The next phase of SWIFT will investigate this as a possible problem for first-year undergraduates and assess the potential of SWIFT to address such a problem.

Overall, we echo one of the main findings from that use of the virtual lab is good preparation for the real lab. We add that the virtual lab can also be good revision after the real lab.

Videos were not shown due to time constraints within the virtual lab. While physical laboratory time is limited, as are laboratory space and staff resources, in trying to circumvent these constraints we found that student time is also severely limited. Medical students in particular – who will be targeted in the next phase of SWIFT – have a very full schedule, and any virtual lab time must be used to maximum effect.

Finally, we note differences in the socialisation process from distance learning projects, such as MOOSE . SWIFT participants tended to arrive in pairs or groups, especially for their second session. Clearly, a real-world socialisation process was taking place in addition to their SL experience. Since participants were sitting together while their avatars were interacting, many interactions took place in the real world – often short comments or non-verbal communication (looks, smiles, sounds, etc.). Everyone knew whose avatar represented whom, and would refer to real or avatar names interchangeably. Questions about the task were asked in both the virtual and real worlds.

Thus socialisation for working together in the virtual world took place in both the real and virtual worlds. Just how participants divided and merged their experience across the real and virtual worlds is unclear. There may be a similarity with experiencing a movie as a group, where real world interaction is used to comment on and augment the technology-created joint experience . We intend to investigate this in future phases of SWIFT.

6. Conclusion

This study investigated the use of an innovative approach to expanding the student experience and learning opportunities of laboratory-based classes. Student participants were given time in a virtual laboratory to learn about the laboratory environment, equipment and health and safety issues, in addition to their regular lab classes.

Participants reported that they had had a learning experience, especially of health and safety information. Participants cited new learning, such as learning about a new piece of equipment, revision, such as the "safety rules", or both new learning and revision. This suggests that virtual laboratories can provide effective learning experiences; future phases of SWIFT will seek to quantify learning gains from virtual lab use.

This study has shown that a virtual laboratory in SL is capable of providing an effective laboratory experience for the learning objectives set. The virtual lab itself supported the students' activities very effectively, the only exception being the demonstrations of manipulating objects. The next phase of SWIFT will take more account of the strengths and weaknesses of the virtual environment.

Participants' views on the virtual laboratory were overwhelmingly positive, with all participants really enjoying their SL sessions. This finding agrees with previous studies and suggests that a virtual laboratory would be accepted by students.

This study found that more than half the participants chose to learn how to use SL on their own prior to the taught SL session. This suggests that the amount of SL training offered to students could be less that the one hour offered in this study, something that the next phase of SWIFT will investigate.

For this study, participants worked together in one place in the real world while simultaneously working together in the virtual lab. Arranging work in this way appeared to help participants engage quickly with the virtual world through their avatar. This observation suggests that encouraging groups to work together in both the real labs and the virtual labs may help students to work together more effectively in the virtual lab, but requires further investigation.

The virtual lab induction activity used in this study provides an excellent basis for subsequent phases of the SWIFT project. The next phase of SWIFT will allow students to investigate case studies for genetic screening using the virtual lab, giving students additional experience of linking practical skills with theoretical knowledge. In the final phase of SWIFT students will use the virtual lab for experimental design sessions in molecular genetics, giving students additional experience using higher-level skills involved in problem-solving and strategic experimental design, and developing team working and communication skills.

7. Acknowledgements

We thank the University of Leicester students who participated in SWIFT for their time, commitment and enthusiasm.

SWIFT is funded by the UK Higher Education Academy through the National Teaching Fellowship Scheme.

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e-Feedback and students' changing needs and expectations

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The provision and quality of feedback on assignments has become a 'thorny' issue throughout Higher Education due to the rapidly increasing undergraduate enrolment and diversified student backgrounds as a result of the internationalization of Higher Education. This paper describes a qualitative study that investigated a group of 1st-year undergraduate students' perceptions of a computer-aided essay marking practice for one large biology course. The study tries to explore the changing needs and expectations of the students for feedback on their written assignments, and examines the efficacy of technologies to meet students' needs and expectations and facilitate their learning through feedback.

Keywords: *assessment, feedback, feedforward, benefits, technology, needs, expectations, quality, learner experience, effectiveness*

1. Introduction

The importance of feedback in students' assignments either by the teacher/expert or classmates/peers has been accentuated in the literature for decades. Hattie's (1987) review of 87 meta-analyses of studies on student achievement and Black and Wiliam's (1998) comprehensive review of formative assessment have both concluded that the most powerful influence is feedback. However, the logistical problems associated with modularization, larger student numbers in first-year classes, greater diversity and reduced staff-student ratios in many universities have all had a negative effect on the quantity and quality of feedback in assessment (Gill and Greenhow 2008; Nicol 2007; Walker, Topping and Rodrigues 2008).

Resource constraints have led most institutions to enlist technologies to help with the assessment process. Some have turned to more automated, computer-generated assessment (e.g., Blayney and Freeman 2004; Walker, Topping and Rodrigues 2008), while some have sought technical alternatives that could aid human markers to provide traditional-style marking and feedback (e.g., Aitken 1998; Bancroft et al. 2003; Campbell 2005). Hence, many aspects of assessment have seen a sea change, e.g., the assignment delivery and submission mode (from paper to online), the assessment format (from essay writing to online discussions/blogs), and the media conveying feedback (from handwritten text to audio/video).

Given the critical importance of feedback and the rapidly evolving technologies associated with it, research on students' expectations for, perceptions of and needs from feedback in general or technology-aided assessment in specific is noticeably underweight (Walker, Topping and Rodrigues 2008; Weaver 2006). Luckily, Nicol (2007, 668) has noted 'a growing interest in the quality of student learning experience' in undergraduate studies recently. The present paper will join the expanding effort to understand the changing learner needs and expectations with regard to new forms of feedback. It first looks into the literature background on feedback, and then describes a qualitative study that aimed to explore: a) the learners' perceptions of the e-feedback practice in a first-year undergraduate course; b) their expectations prior to and after their experience; c) the aspects of feedback that mattered to them most; and d) their preferences for different forms of feedback.

2. Literature on feedback

Denton and others (2008, 487) remind us that 'in an era of sophisticated learning technologies, the criteria for effective feedback remain the same'. To understand the criteria, let us first look at what constitutes feedback.

Interestingly, Ramaprasad's (1983, 4) definition of feedback, although originally proposed within the discipline of management, has been widely cited in the educational studies literature: 'Feedback is information about the gap between the actual level and the reference level of a system parameter which is used to alter the gap in some way'. Ramaprasad also emphasizes that 'if the information on the gap is merely stored without being utilized to alter the gap, it is *not* feedback'(p5).

Self-evidently, this definition indicates that criteria for effective feedback must be two-fold: 1) how clearly the 'gap' is illuminated; and 2) how well students are motivated to use the feedback. There are some excellent studies and literature reviews (e.g., Brown and Glover 2006; Gibbs and Simpson 2004-05; Sadler 1989) that have summarized the principles and conducive factors that reflect these criteria (see Table 1 below). For instance, while some researchers (e.g., Nicol and Macfarlane-Dick 2004) advocate the efficacy of positive comments, some argue that comments of a praising tone actually damage learning (Dweck 2000). Also, Lunsford (1997) proposes the principle of providing only three well thought out comments per essay.

The Gap	Conducive Factors
Where is the gap?	Timeliness
What is the gap about?	Legibility
How to alter the gap?	Quantity
	Clarity
	Tone

Table 1. The principles and conducive factors that reflect the criteria for effective feedback

Among these qualities of feedback, one critical, but often underestimated, factor is 'clarity' or understandability of the meaning of a given feedback. Sadler (1989) asserts that, for feedback to be cognitively internalized by the learner, the following three conditions must be met: 1) the learner must understand the standard (or reference level) being aimed for; 2) she must compare the actual level of performance with the standard; 3) she must actively engage in appropriate actions which leads to some closure of the gap. Nonetheless, we often take it for granted that providing feedback to the learner will automatically lead to self-correction and improvement, whereas in reality the messages are often unusable or too complex for the learner to decode (Gibbs and Simpson 2004-05; Nicol and Macfarlane-Dick 2004; Shepard 2000), because students are often unversed in the particular orientation of a discipline (Lea and Street 1998). A typical example is MacLellen's (2001) survey, which revealed a drastic discrepancy between the lecturers' and the students' perceptions of feedback: most teachers considered their feedback to students helpful, while 30% of the students reported that feedback never helped them to understand.

Another discouraging fact is that feedback information is seldom about aspects that are abstract and difficult to define but are of great importance to academic learning (e.g., structure of argument) (Nicol and Macfarlane-Dick 2004). Draper (2009) echoes claims that many teachers do not address the most immediate need of many newly enrolled undergraduate students or what is actually in the long run the most important to them. Moreover, the aforementioned dilemmas of the modern 'mass higher education'(Hounsell and Hounsell 2007)—the decreasing teacher-student ratio and modularization—have forced many teachers to restrict their feedback comments to a few terse lines.

Therefore, a general concern is whether we are providing our students with the appropriate kind and amount of usable feedback they need to 'alter the gap' effectively. Can technology aid us in providing feedback that meets the aforementioned criteria? A fair number of studies demonstrate that e-feedback has certain incontrovertible advantages over the traditional pen-and-paper methods, e.g., elimination of physical delivery, and the ease of production of electronic comments and marking rubrics. Bridge and Appleyard's (2008) survey found that 56% of the respondents expressed a preference for electronic submission and feedback. Denton and others' (2008) comparative study also confirmed the pedagogic value of the structured Word-processed feedback produced by their e-marking software. The authors' institution has

also implemented a similar innovation for an undergraduate course. While most research on electronically annotated feedback adopted quantitative methods for investigations into students' experiences (e.g., Aitken 1998; Bancroft et al. 2003; Cargill 2001), this study opted for a qualitative method in an attempt to probe into students' perceptions in more depth.

3. Background

The course concerned (named 'course D' hereafter) was a foundational course for about 400 first-year undergraduate biology students. The students were asked to write an essay which accounted for 25% of their final mark for this course. Although the marking work was shared among about 15 teaching staff members, due to the sheer volume and limited time, the whole process was still a considerable maneuver for both the markers and the administrative staff. Naturally the situation called for more efficient organisation of quality feedback delivery. e-Marking procedures were thus conceived, involving the use of 20 dedicated tablet PC laptops, Microsoft Word, Excel, the University-wide virtual learning environment (VLE), and the screen capture software Camtasia. The whole workflow is detailed in Figure 1.

Almost every step of the procedure was transmitted electronically which saved time and eliminated

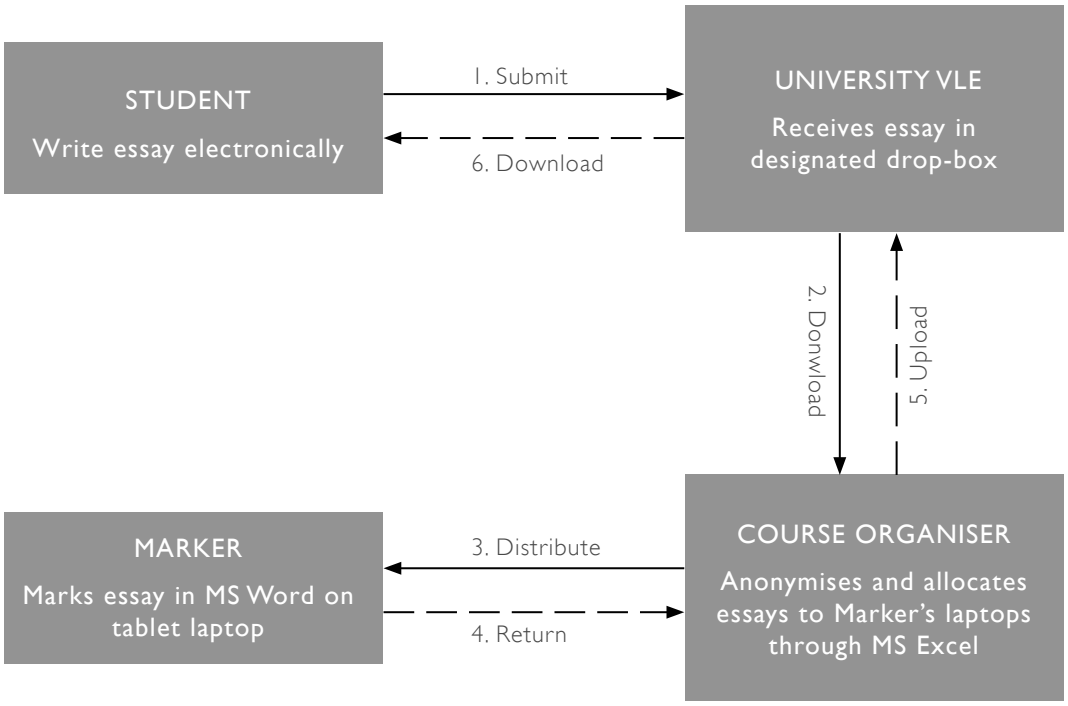

Figure 1. Course workflow

some logistic problems, so that the teachers could spend more time providing feedback rather than paper shuffling. The major goal of this e-marking practice was to let technology help the teachers to produce feedback of greater clarity, consistency and relevancy. A series of bespoke Microsoft Word and Excel macros had been developed by a learning technology expert. These macros, preinstalled on the tablet laptops, enabled the markers to:

- mark through a list of papers without having to keep records manually;
- view an essay on the tablet laptop in a portrait mode just like a normal paper as the laptop screen is of A4 size;
- mark on the essay using a stylus pen just like marking on a paper-based essay using an ink pen;
- annotate the essay with textual or graphic comments through the customized macros;
- capture screen movements and record audio comments by using Camtasia embedded in Microsoft Word.

Thus, the students received mainly two types of feedback for the assignment: textual and audio-video comments.

4. Methodology

This study was an initial attempt in this institution to identify students' perceptions, needs and expectations of e-feedback. It was intended to be a small-scale, exploratory investigation which might reveal some clear pointers for further studies where more quantitative methods might yield more specific triangulation evidences. Hence, at this stage, only one research method was employed in this study.

4.1 Research instrument

A qualitative research method—group interview—was chosen for this study due to its possibility of probing into the less quantifiable learner attributes as well as yielding richer data. The validity of the instrument was ensured through focused literature review and careful construction of questions that were in resonance with the aims of the study. It contained 5-7 semi-structured questions which gave the interviewer the flexibility to elaborate if the interviewees' responses called for further investigation. The questions were centered upon the factors of effective feedback described in Literature Review. For example, the students were asked whether they thought the e-feedback they received was sufficient and understandable, their perceptions of its quality in comparison with traditional written feedback, how they made use of it, and their needs and expectations of feedback in their university study.

4.2 The sample

The interviewees completed Course D in the first semester. During the second semester, several classes were approached immediately after their lab sessions on different dates, and some students volunteered to be interviewed on this topic. Due to the availability of volunteers, the number of participants for each interview varied from one to five persons.

4.3 The data

Seven interviews, involving 25 interviewees in total, were completed by the first author, and the interview lengths varied from thirty minutes to about an hour. All seven interviews were recorded digitally and transcribed to a near verbatim standard by the first author, and the transcriptions were then verified and amended by the second author. Interpretation of interview data is inevitably subjective; therefore this paper tries to present as much authentic data as possible to illustrate the findings.

Admittedly, with a single research method and a self-selecting sample, the findings from this study may not be generalizable, but they may be of interest to teachers in comparable undergraduate teaching contexts.

5. Data analysis

Coincidentally, when the investigation was conducted, the students had just received feedback for another course (named 'Course M' hereafter, attended by 365 students) in the traditional manner. During the interviews the interviewees all spontaneously compared the two essay experiences.

As the interview subjects were volunteers, the cohort turned out to be fairly heterogeneous. There was a mix of male and female, UK and international students. It was obvious in the interviews that some of them had done well in their essays and were high achievers while some performed less well and were more passive learners. Nevertheless, even with such a diverse cohort, surprisingly consistent patterns appeared in the responses about feedback across the interviews. An iterative coding analysis revealed the following recurring themes.

5.1 Promptness

The importance of the timeliness of feedback has been emphasized in the literature (Gibbs and Simpson 2004-05; Nicol 2007; Nicol and Macfarlane-Dick 2004). All the interviewees were satisfied with the promptness of the feedback. They reported that the feedback for Course M was returned even faster than Course D. However, they were in fact more concerned about the quality rather than the promptness of feedback. As one student asserted:

> *'I'd rather have my essay feedback a bit later, knowing that the marker had thought about it a bit more than just going through them in a really really quick time and then just read them once.'*

There was a general discontent with the Course M feedback which typically only contained a general comment on the front page.

5.2 Prior expectations

Overall, e-feedback was considered much better than what the students had expected from their first-year of study.

> *'I'd say the feedback is very very good. Yeah, better than I expected. I'm surprised that they take so much time for, especially, the first years because we're not really that important in first year.'*

Most students had expected either just a mark or a few lines of general comments beside a mark.

5.3 Preference – electronic feedback

All but one of the interviewees clearly preferred e-feedback to traditional paper-based marking. A number of strengths were mentioned in the interviews.

5.3.1 Easier access

The usual way of submitting assignments and delivering feedback in this institution is rather 'unsophisticated'. Students put their work into a locked box and then retrieve their feedback from a table in a public area where all the marked papers are laid out in the open. Students identify their own work by PIN numbers printed on the papers. Nearly all the interviewees were very critical of this system. They complained that the 'feedback table' was often a total mess, they had to queue for a long time because of the large number of students, and they often could not quite remember their PIN numbers. One student even reported that her paper had gone missing. In contrast, the electronic submission and feedback delivery through the VLE offered much easier access. Not only could they submit essays from anywhere with better security, but also they could receive the feedback more efficiently and safely.

5.3.2 Privacy

Another advantage of e-feedback was privacy. The following comment was very representative of the students' views on this issue.

'I think it's good because it keeps it private as well. You don't have to go with lots of people and pick up your essay, and then they go 'oh what did you get'.'

5.3.3 Quantity

The most striking difference the interviewees found between Course D and Course M was the volume of feedback. It was almost unanimously acknowledged that Course D provided much more detailed feedback.

> *'Course D, I was impressed. They marked the essay with the little comments, but they also gave overall feedback of that marker's group. So you got a lot of feedback from Course D, but Course M, it was worse than I expected.'*

This advantage of e-feedback is probably unsurpassable by the traditional marking, because there is simply not enough space between lines or on the margins of the paper if the marker has to hand-write the same amount of information.

Not only that the students received plenty of very specific, typed comments throughout their essays, but also some students even received additional audio-video feedback. These students reported that audio-video feedback contained much more information than a teacher would normally write, was easier to comprehend than handwritten comments, and felt more personal 'coz you can actually listen to the person who actually marked it rather than just getting a mark on a piece of paper'. Some interviewees said they listened to their audio-video feedback repeatedly or even took notes to make sure they really understood the information. This mirrors the findings reported in Merry and Orsmond's (2008) study on audio feedback.

5.3.4 Quality

Quality was the second most outstanding reason from the interviewees' explanations about their preference for e-feedback. The students generally felt that the depth and constructiveness of e-feedback was beyond their expectations.

> *'I would say it [e-feedback] was certainly as good as expected. Maybe even better. Yeah, there was certainly a lot of feedback which did help.'*

In comparison, most of them thought the feedback for Course M was less helpful.

> *'The Course D one seemed to have a bit more of a good explanation of where I'd gone wrong, whereas the Course M they just kind of wrote on the front, they don't focus.'*

5.3.4.1 Legible and precise marking indicators

An indisputable strength of e-feedback is its legibility. The interviewees commented that the typed feedback was definitely more readable than hand-written comments. The customized macros within Word enabled the Course D teachers to highlight, draw and insert comments wherever necessary in an essay. The students found that e-feedback was much clearer as they could see precisely where their weaknesses/strengths were and the ways the markers suggested to improve.

> *'I really really like what we got for the Course D essay because throughout the actual essay, you had a lot of commentary on the side of your essay so you could relate to where you'd gone wrong.'*
>
> *'They'd actually highlight bits of the text in red ... and written in little boxes at the sides so it was directly linked to it so that you don't have to keep looking backwards and forwards. You can just read through your essay and read all the comments on the sides.'*
>
> *'That Course D one got a video feedback, so they talked you through exactly where, you could see it on the screen.'*

An interesting contrast was reported in one interviewee's response:

> *'Throughout the [Course M] essay, s/he had underlined or circled things, but hadn't actually explained why/ what that was, ... so I'm still wondering what is it that's wrong with it.'*

This was probably more due to the spatial constraints on the paper rather than the teacher's willingness to expound.

5.3.4.2 Understandable and constructive comments

Most interviewees agreed that the e-feedback comments were more constructive about how to improve.

> *'It explained to me like, where I'd lost marks on and how I could improve them and how my essay all tied together.'*

One student experienced two distinctly contrasting scenarios in Course D and Course M:

> *'From my first[Course D essay], my video feedback, I got what I actually wanted'*
>
> *'For certain reason, I got my Course M paper back, and what I read was a bit strange for me because I didn't really know how to interpret it.'*

Obviously, the e-feedback he received was of greater clarity, and thus it was more 'usable' for his future learning.

The interviewees also found feedback on skills for writing scientific essays very useful, e.g., referencing, using figures, structure of an essay, etc.

> *'It explained the reasons ... why your introduction needed connection with the rest of essay, or something like that. It was good.'*
>
> *'If you had...something that maybe wasn't relevant, it'd say, 'you could leave this out in the future' or 'this bit's not right and you maybe need to change your graph slightly'.'*

It was very clear in the data that most interviewees valued this type of comment greatly, and expressed a strong request for more such comments in future.

5.4 Needs and expectations

The interviews revealed several common learning needs and expectations about feedback among this cohort of students.

5.4.1 Wider implementations

The majority of the interviewees held the opinion that the electronic form of essay submission and feedback should be used in all courses. It did not only save time and 'hassle', but also saved paper. In addition, most students thought audio-video feedback was, as one student put it, 'a good idea and should spread out.'

5.4.2 More feedback

The students repeatedly mentioned a need for more feedback on assignments, although many also appreciated the fact that each teacher had to shoulder a large marking workload in the current Higher Education context.

> *'You can't have too much feedback, whether it's praise or criticism. ... getting a number is completely pointless. We do need to have an explanation of the numbers on there. ... It's been enough, what I've had so far, but obviously I would like more.'*

They would like to see a greater provision of instructions on how to improve for their next assignment, especially, more examples to model on. Corresponding to what McKenzie (2004) has stated, this study also confirmed that high achieving students often need feedback as much as those who have performed less well.

> *'If one has really really good essays, ... [the marker should] still try to give points where one could improve, ... when you get an essay with a mark of, say 80, basically what you get is a feedback 'brilliant essay' and that's it, but you still feel there's 20% missing as well and where has that 20% gone then.'*

5.4.3 More guidance on scientific writing

The majority of the interviewees did not know how to approach their first essay task and would have liked to have more guidance on writing techniques and norms for scientific papers. They had realized that writing a scientific essay at university level was completely different from how they wrote at schools. Many reported that they had never had any training in writing scientific articles prior to university. Hence, they lacked knowledge on what writing style to use, how much depth to go into, how to use graphs and references, and what disciplinary conventions to follow. They realized that they needed to make a transition from school

English essay writing to university science writing, and expected the teachers to provide more feedback or even training on writing skills. As one interviewee observed, 'I can have the understanding, it's just how to present our understanding.' This type of feedback is termed as 'comments on skills development' by Brown and Glover (2006).

However, such comments were not as desirable to the students who had achieved good results and were more confident in their writing skills. They typically looked for 'comments on content' (Brown and Glover 2006).

> *'I would rather have them to talk about actual biological aspect of what's going on rather than scientific writing sessions.'*

Moreover, such students also had a clear preference for critical rather than praising feedback.

> *'I would much rather have a feedback that's negative to help you improve. It frustrates me when my mark isn't 100% and yet all my comments were just 'very good' 'very good' 'very good'.'*

5.5 Feedforward?

43% of the interviewees reported they had revisited the feedback from the Course D essay. Especially, all the students who received audio-video feedback reported they reviewed what was wrong and the specific remedial suggestions in their Course D feedback before they worked on their next assignments.

6. Discussion

This study revealed some distinct changes in the needs and expectations for feedback on assignments among the entry-level undergraduate students.

First of all, the promptness of feedback was not a pivotal concern for these students. They would appreciate a concerted effort for higher quality feedback even if that meant they might have to wait slightly longer.

Secondly, although before their university education, most students had experienced feedback in forms of marks and a few comments only, they reckoned now they would need more detailed feedback on assignments. Walker's (2009) interviews with 43 first-year and second-year undergraduate students in engineering and computing found that their students valued comments on skills development most. This tendency was confirmed in this study: these participants also emphasized that they needed more feedback on their scientific writing skills in addition to information on the subject knowledge and specific 'disciplinary ways of thinking' (McCune and Hounsell 2005). They asked for examples of how to accomplish a task properly, which showed that they were actively seeking to understand the 'reference level' and gauge the breadth of the 'gap'. A fair proportion of them made use of the diagnostic feedback and tried to 'close the gap' before their next assignment. Moreover, it seemed that the high-achieving learners expected more comments on content instead of comments on skills and were more likely to be motivated by constructive criticisms rather than praising comments.

Thirdly, most interviewees felt that the electronically marked assignment met or even exceeded their needs and expectations in terms of the promptness, privacy, quantity, clarity and constructiveness of the feedback. They perceived the e-feedback as being particularly adequate in quantity and understandability, and thus more helpful to their learning than traditional written feedback. All of them except one preferred to have e-feedback and suggested it should be implemented in all courses. This is a much more distinct inclination than the earlier findings from Bridge and Appleyard (2008). This may be partly owing to the evolving capabilities of technologies, and partly because nowadays undergraduate students are more and more 'e-ready' when entering university.

7. Conclusion

Although the study involved a small cohort of students, there appeared a remarkably clear picture: these students perceived feedback quite differently from what is commonly observed in the literature—that feedback is often unusable or left unattended at all by students (Hounsell 1987). The authors believe that, although criteria for effective feedback remain the same, students' experiences are changing due to the quality of feedback enhanced by technology. Evident in this research, students were more likely to 'go back to' feedback if it was of adequate quantity and quality in accordance with their expectations and needs.

The ultimate pedagogic goal of assessment is for students to be motivated to internalize their feedback knowledge and transform it into feedforward for their future learning. Nicol and Macfarlane-Dick (2004) assert that 'feedback' and 'feedforward' should be systematically embedded in curriculum practices. This study suggests that integrating appropriate technologies into assessment may, to a certain extent, augment teachers' effective evaluative practices and strengthen this link between 'feedback' and 'feedforward' for students.

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Web-based collaboration in Higher Education: small steps towards adoption

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This paper reports on the early adoption phase of Google Docs as a web-based collaborative tool across six institutions in a concerted effort. The adoption approach was based on a custom framework in order to focus on users and their actual needs, and the adoption was driven by a small project team as opposed to institutional managers. This study therefore reports on suitability and value of the custom framework and on issues of innovation adoption originating from the institutional periphery.

Users were reporting a high satisfaction with the tool, and findings show that the use of the tool enhanced collaboration significantly, in turn improving the quality of student learning. The main concern of this paper, though, is the evaluation of the custom adoption framework. This framework is based on the idea of not overwhelming users, instead introducing small, gradual steps with a technological innovation that is appropriate for their needs. Based on a review of existing adoption models, we attempted to address common issues of individual-based adoption models in our given context.

Overall, the framework was successful but needs adaptation. Concepts such as technological gaps do not always align to user perceptions. With some suggested adaptations, though, this framework can be used in similar scenarios.

Keywords: *changing tools, collaboration, Web2.0, uptake, adoption, innovation spread*

1. Introduction

This paper reports on the early adoption phase of web-based collaborative tools across six institutions in a concerted effort. The adoption approach was based on a custom framework in order to focus on users and their actual needs, and the adoption was driven by a small project team as opposed to institutional managers. We report on suitability and value of the custom framework and on issues of innovation adoption originating from the institutional periphery.

The motivation for the project was born out of the ambition to promote the use of innovative technology beyond a small group of early adopters and prepare the average user, be it a lecturer, student, administrator or researcher, for realising the benefits of new technological developments in the area of web-based collaborative tools. We therefore deliberately selected Google Docs as a tool whose use incurred no additional costs to users or their institution. Google Docs is a suite of three web-based office applications: a word processor, a spreadsheet application, and a presentation tool. Google Docs is accessed and operated through a standard web browser and has collaborative functions built in, allowing multiple authors to edit one document at the same time. The functionality of Google Docs complemented current institutional services, the tool displayed a potential of future integration with existing infrastructure, and it was identified as a good example of typical emerging functionalities. Also, users would be able to continue using this tool beyond the project lifespan, thus turning the study into a real-life scenario and potentially an actual adoption.

We pursued two main aims during the study:

1. Introduction of collaborative web-based tools to enhance current practices:

   This project aimed to help bridge gaps in the technical skills of our users, and to illuminate the impact of collaborative tools on the practice of various stakeholders at Higher Education Institutions (HEIs).

2. The trial of our adoption framework and its evaluation:

   We created our own adoption framework, building on existing work but adapted to our specific needs. This project provided an opportunity to apply this framework in practice and test its potential for similar initiatives.

2. Background

This section explains the thinking behind the project ideas and locates our activities in the relevant field by making links to appropriate literature.

2.1 The need for collaborative tools

Lifelong learning is one of the most important skills to master, and one of the vital functions of HEIs is to help students grow and develop by keeping up to date with new learning methods and styles, catering to the learning experience of all individuals and addressing their individual needs. It makes sense for education at all levels to move towards greater use of collaboration, which according to Beckman (1990) has many advantages. These include reducing the stress of working alone for long periods of time, greater achievement through discussion of issues by people with differing opinions and making tasks appear less daunting by providing a collaborative environment. Learners also report that learning is more enjoyable when applications are user-friendly and when working in groups that are socialising. Franklin and van Harmelen (2007), too, stress the value of group work and social constructivism in developing effective teaching and learning environments.

But there are more advantages to collaboration. Diana Laurillard's Conversational Framework (2002) for example highlights the value of collaboration to the learning process because it addresses vital feedback loops that help learners engage more deeply in refining their reflections and actions. Collaborative tools such as Google Docs can address large parts of this process: they can be appropriate for learning through inquiry, discussion, practice, collaboration and production and thus provide rich opportunities for engagement. The important issue, though, is to use these tools in appropriate settings and embed them in practical teaching strategies. These two aspects are at the core of our custom adoption framework.

Collaborative tools need not be restricted to learning. In other sections of HEIs, people co-operate on a range of activities, including administrative and research tasks. One significant feature of recent web-based tools is their ability to bring such different users together through collaborative working practices; however, one barrier to using technology, especially innovative technology, is the skillset of users: Marc Prensky (2001), for example, sees a generation conflict between digital natives and digital immigrants. But the new generation's confident use of technology, including multi-tasking, flexible and independent working, often does not sit comfortably with other users' more limited technical abilities, creating a challenge for institutions that want to adapt to learning and working styles fostered by new technologies (Dede 2005) to capture their benefits.

Interestingly, Prensky himself (2009) now advocates looking beyond his digital native typology and focusing on the development of Digital Wisdom to prepare ourselves for the future and not end up on the wrong side of an increasing digital divide. We argue that collaborative tools could go some way to helping users along this way, bridging the skills gap to some degree. Our project therefore sought to exploit this opportunity by identifying Google Docs as a tool that is simple enough to be used and shared by all stakeholders, because of its similarity to familiar less collaborative desktop-based tools. The addition of a web-based collaborative component would thus facilitate a small-step approach to becoming more confident with innovative technologies.

2.2 *Innovation adoption*

This section provides a background on existing research on innovation adoption that is relevant to this particular context.

In a substantial review of literature, Tornatzky et al. (1983) distinguish and discuss different innovation adoption process models, based on the observed assumption that innovation is a "process of many discrete decisions and behaviours that unfold slowly over time", which "involves social units at many different levels of aggregation" (Tornatzky et al. 1983). Innovation adoption can therefore comprise developments that are not always overt acts and that may proceed outside of the organisational consciousness (Eveland, Rogers, and Klepper 1977). A non-overt innovation adoption process, once identified, will thus face at some point the challenge of making itself known within the organisation.

The general models of innovation adoption processes are, according to Tornatzky et al. (1983), technology-source-centred models, which view the process from the perspective of the technological development, and user-centred models, which focus on contextualised applications and tend to start where the source-centred models end. The user-centred models can be further distinguished between organisation-based and individual-based models, depending on the focus of the analysis. The perspective adopted in this study is that of individuals at the early stages of a technological innovation adoption process. This is because we were working with a low number of volunteers, which hardly represents an organisaion-driven adoption.

The most widespread individual-based innovation adoption model is that of Rogers (2003). Based on a very substantial research analysis, he suggests the following five main stages of an adoption process, although he acknowledges that more or fewer stages may exist:

1. knowledge,
2. persuasion,
3. decision,
4. implementation, and
5. confirmation.

Other models (Hall 1973; Hamelink 1984; Havelock 1973) are conceptually not too dissimilar to Rogers' model, which was originally developed in the 1960s, and can be mapped with some variation onto his five stages.

This paper does not examine a complete organisational adoption process; instead it looks at initial contributing factors. This is what Rogers does by explicitly attaching his stages to a decision process, which he frames within prior conditions such as *previous practice, felt needs/problems, innovativeness and norms of the social system.* These are helpful prompts and therefore used as guiding ideas in this study, although in an adapted from. Adaptation is particularly important as Damanpour (1991) warns that innovation adoption process models should not be one-dimensional and not disregard organisational influences, as these influences will impact on the actions of an individual, who is always a part of and interacting with the organisation itself (Hofstede 2005).

Damanpour's warning is one of several points of criticism of individual-based innovation adoption process models. Rogers (2003) for example highlights a pro-innovation bias in most models, ignoring exit strategies in the case of failure; Levine's (1980) book on innovation failure in Higher Education and Conner and Patterson's (1982) eight stage model are notable exceptions. Roger criticises a lack of methodological rigour, leading to disengagement with objective observational procedures in most if not all models. Aboelmaged (2000) adds a narrow focus, or ignorance of a faculty- or institution-wide application, as well as a bias on instructional technologies, or ignorance of administrative innovations, as further criticisms. These criticisms are certainly valid for all stages that demand organisational commitment beyond the influence of a small number of individuals. And although we did not operate in this context, we took these as warnings into account, for example by including administrators as a stakeholder group.

Finally, we looked at Fowler and Scott's (2007) Users and Innovation Development Model (UIDM), which represents a bridge between user-centred and technology-source-centred models. This model's cyclical nature and comprehensive guidelines appeared to meet our project's methodological needs, so we incorporated its phases into our project and synthesised its ideas with those from the innovation models above to create our own framework.

2.3 Custom innovation adoption framework

For our framework, we used a STAIRS metaphor, which doubles as an acronym to highlight the involvement of different stakeholders: students, teachers, administrators, innovators, researchers, and support staff. The framework is based on four stages as explained below.

2.3.1 The Gap

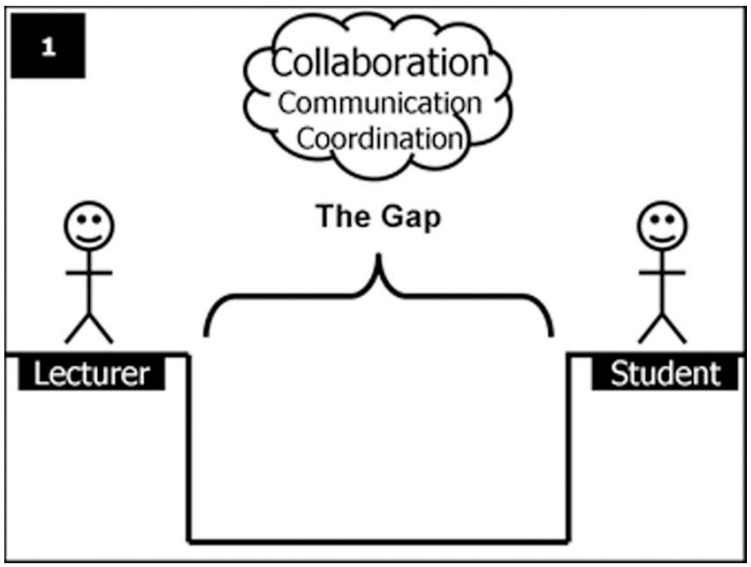

Figure 1. The Gap

The lecturer and student are separated by a technology gap. Whilst each might be happy using some forms of technology, such as office applications for the lecturer and social networks for the student, these different tools do not allow them to benefit from the potential to collaborate, communicate or co-ordinate. The labels Lecturer and Student can be exchanged to Researcher, Administrator, or any other role, depending on the context.

2.3.2 Steps

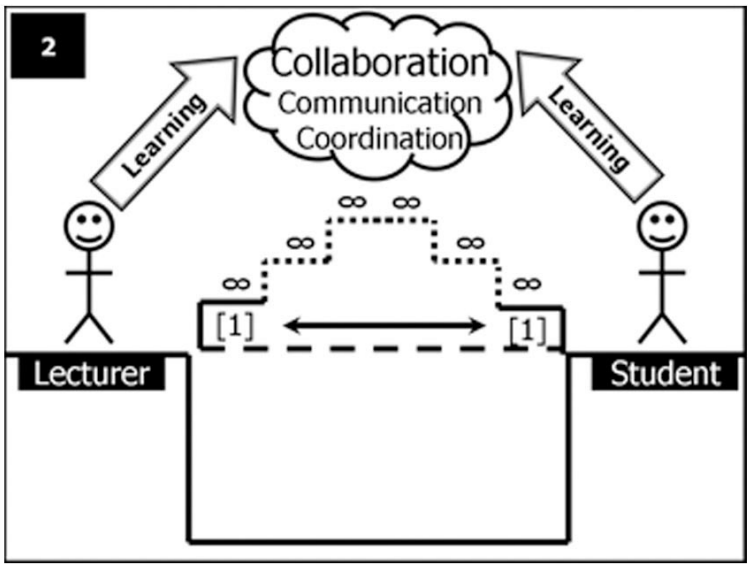

Figure 2. Steps

The initial step for each user should be small to ease the transition towards new collaboration processes, which makes some demands on the technology. The learning arrows represent the new potential to learn how to collaborate, communicate and co-ordinate whilst the horizontal arrow depicts the opportunity to bring users with different skills and understandings closer together through technology.

The figure of eight on each step indicates that this progression uses the iterative UIDM model to build on existing understanding of the users to help identify the appropriate technologies to make this progression.

2.3.3 Development

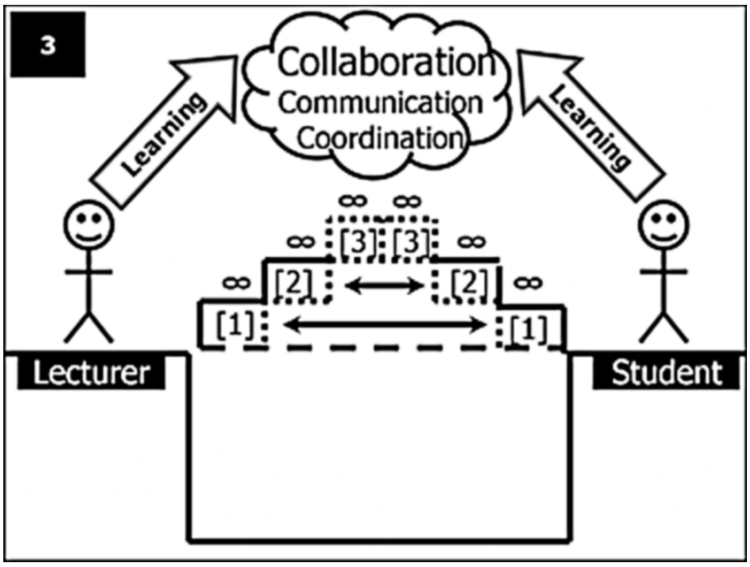

Figure 3. Development

By encouraging users to take small development steps, we aim to encourage users and thus enable them to take the next steps with collaborative technologies, building on previous experience. For example, a user who has started to work with Google Docs is likely to feel more confident to take the next step in using other technologies, for example wikis.

2.3.4 Institutional Integration

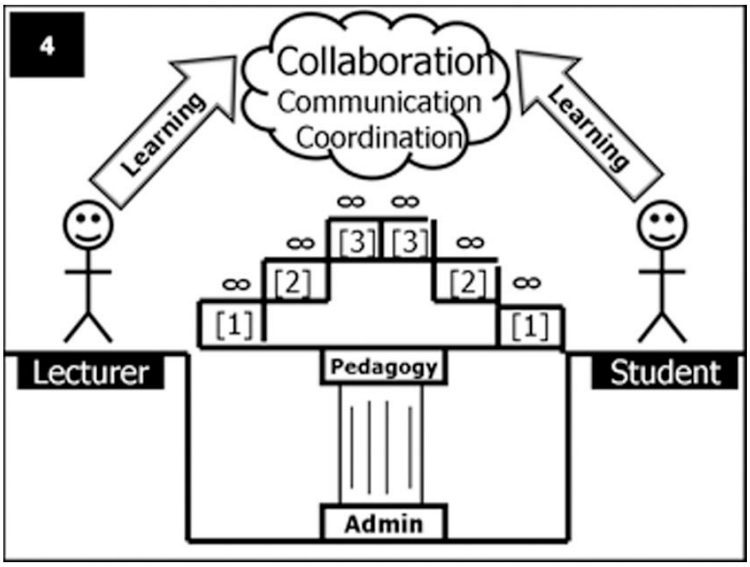

Figure 4. Institutional Integration

The final support mechanism for this project is the engagement of a wider spectrum of institutional stakeholders. This includes engaging the support departments within each of the institutions to adopt the technology on an institutional level. The pillar above represents the institutional integration and signifies sustainable use of the technology.

3. Methods

The work in this project was organised into five main phases, which are briefly described below to provide context. This paper, though, focuses on the evaluative aspects of our adoption framework, for which most other data collected during the project has only indirect relevance. The five project phases were:

1. Background research: A large-scale institutional questionnaire survey to learn about technology use by different stakeholder groups.
2. Technological development: Small developments integrated Google Docs into our Virtual Learning Environment.
3. Demonstrator pilots: Seven independent pilots across six institutions represented individual small-scale adoptions and formed the core of the project.
4. Evaluation: Pre-pilot interviews, continuous engagement with the pilots, and post-pilot questionnaires and interviews provided us with a rich set of data.
5. Dissemination: A comprehensive dissemination strategy was also used to raise awareness and trigger post-project adoption.

Pilot leaders were identified by learning technologists across institutions and participated on a voluntary basis. We aimed to involve all partner institutions and relevant stakeholder groups and ran the following seven pilots:

Pilot	Institution	Description
A	Royal Veterinary College (RVC)	RVC AHEMS Reviews First year veterinary students created and edited among themselves a database of farm placements to share their experiences.
B	Royal Veterinary College (RVC)	RVC Library Spreadsheets Library staff created a database for book suggestions and orders. All students and staff at two campuses were asked to contribute.
C	London International Development Centre (LIDC)	LIDC Membership Administrators built up a shareable database of academics working in the area of international development.
D	School of Oriental and Asian Studies (SOAS)	RSS Portal PhD students created a Research Students' Society (RSS) portal for the SOAS website to help with their research and planning by collaboratively compiling information for different research stages.
E	The School of Pharmacy	Medicine's Profile Exercise First year students created, edited and shared group information on drug variables as a part of a mandatory exercise.
F	Birkbeck College	Easy PC Learning Lecturers and Biology students explored new ways of collating data in real time to carry out collaborative learning.
G	London Knowledge Lab	Collaborative Research Environment Researchers built internal and external team websites to collaborate on research projects.

Table 1. Demonstrator pilots

To evaluate the suitability of our adoption framework, we interviewed the pilot leaders of the six pilots A to F and reviewed the use of the technology for pilot G through usage statistics. The analysis of the data focused on two broad areas. Firstly, we were looking for evidence statements related to functionality, management, and experience. Secondly, we asked the pilot leaders directly about the suitability of our adoption framework, which was introduced to them before the start of the pilots. In addition to this, general satisfaction and usage levels were occasionally used for triangulation purposes.

4. Discussion

The first part of this discussion briefly presents some user responses to the technology, and the second part reviews our adoption framework in light of feedback from our users.

4.1 Response to the technology

All the pilot leaders regarded their pilots as being successful and would repeat their pilot or keep it going. However, a greater measure of success was evident in how all interviewed were more positive about using collaborative technology: users were either prepared to consider other collaborative technologies or to improve other areas where they could be made applicable.

Actual success factors can be grouped into four categories:

1. Engagement with new technologies
2. Better content understanding
3. Higher efficiency
4. Idea generator

4.1.1 Engagement with new technologies

While none of the pilot leaders had prior experiences with Google Docs, they all reported that the cross over to Google Docs was an easy transition. Some of the pilot leaders commented about the lack of features in comparison to their desktop application, but also were more interested in how the technology could help the process, not in the actual technology itself. In this regard the collaborative nature of Google Documents exceeded their expectations.

Even though our pilots had different requirements, pilot leaders reported that the tool met most of them. All pilots highlighted ease of access as a key feature and outcome, as well as location-independent access of the data. In this respect, the tool was preferred to existing institutional services, such as network drives as plain storage for data to be used with client-based local applications. Five of the seven pilots wanted the ability for multiple individuals to access and edit a document at the same time, a functionality they did not have access to before. Consequently, the tool was regarded as excellent for collaboration, with 83% out of 150 student participants of pilot E wanting to use the tool again for collaborative writing.

4.1.2 Better content understanding

We were initially surprised to find that pilot leaders in pilots A, D, E and F reported a number of successes in relation to student learning, especially in pilots A and E, where the same activity was simply transferred from face-to-face to online, with only very minor changes in the activity design. In the case of pilot A, the style, immediacy and ease of access of the reporting created by the technology encouraged students to be less guarded about their experience reports on placements and allowed staff to understand and identify teaching needs that were not previously regarded as a learning issue. In pilot E, submitted work showed a deeper level of understanding about the role of pharmacy, which was also a result of better group work: in the face-to-face mode, it was sometimes left to one person in a group to do the work, whereas online, all students were contributing.

While the improvements are attributable to the technology, the potential to achieve similar levels of engagement and understandings was there before and could probably have been unleashed by different tutor interventions. But technological factors fulfilled some of these functions; therefore it can be argued that, even though the tool may not directly facilitate learning per se, it helps optimise the conditions for learning to occur.

4.1.3 Higher efficiency

Pilot participants reported that the use of the tool resulted in general reflections of their work processes. This is a typical function of any change, for example a change of teaching methods: changes force people to rethink their approaches and make conscious decisions. The success factor that technology can offer is efficiency, i.e. the identification of more productive processes.

Some efficiency gains can indeed be attributed to the technology. In pilot F as an example, the tool allowed students to edit a common document directly at the time of data collection instead of in between lessons, resulting in substantial time-saving and an instantaneousness that did not exist before. The other pilots reported that the collaborative features allowed them to distribute tasks more easily, and that less work on managing individual contributions was required.

4.1.4 Idea generator

Our pilot participants, both pilot leaders and students or other stakeholders, came up with new ideas how to use the tool under investigation or which tool to tackle next. The process of getting to know a new tool triggered a range of ideas that can be grouped under the following headings:

- future developments and further refinements of the current pilot;
- use of Google Docs for other things;
- use of other Web 2.0 tools;
- dissemination and encouraging other staff members to use the tool.

The fact that all pilot leaders had thoughts about new possibilities is a clear indication that they had been happy enough with their current experience to consider taking it further forward and to also consider alternative applications. In relation to our adoption framework, this appears to confirm the suitability of our small step approach, although the exact nature of the steps is debatable, in the light of the data below.

4.2 Review of the STAIRS adoption framework

It was very noticeable from responses that although pilot leaders had been informed of our STAIRS framework, they had not really considered it for their original pilot design. This was not entirely unexpected, as the overall project staff were the main users of the framework and used it to engineer the pilots and guide them in the spirit of the framework. The pilot leader feedback, however, is invaluable in determining whether or not the ideas of the framework were reflecting the pilot experiences appropriately. We therefore asked pilot leaders to comment on all four stages of our STAIRS framework.

4.2.1 The gap

All leaders were able to identify a gap or gaps that their pilot had been able to bridge, but the true nature of the gap or gaps were only identified in hindsight. Using the technology gap as an example at the start of the demonstrator pilots appears to have been confusing and forced some individuals into a mindset.

Pilots B, F and G did not find the gap concept helpful or applicable. They felt that any gap between users would be an artificially constructed idea: they focused more on the functional components of the technology as opposed to concentrating on differences in skills. The other four pilots found the gap concept quite appropriate, although interpretations as to what the gaps were that needed bridging were very diverse.

This shows that our initial concept of attempting to bridge a skills gap with technology was too naïve for the various contexts of our pilots. Replacing the gap metaphor with more abstract *needs* or *purpose* concepts would be more applicable and, most importantly, more flexible, as all of our pilots had very different requirements. The concept of *addressing needs* would have worked for all pilots, including those who did not identify a gap, but used technology to improve their practices, and thus reach higher levels, which begs the question whether the step concept was appropriate.

4.2.2 The Steps

All pilots found the concept of *steps* and *stepping up* useful. Google Docs was perceived as a first small step, as it was relatively simple, so that everybody could use it and move to the next step of being collaborative. However, a comment by pilot leader D neatly summarises the fact that the steps aspect of the STAIRS framework is not limited to keeping the technology simple:

> *"... the steps model can work but it's not just one set of steps. There are many different sets of steps for many people according to their aims."*

This lecturer thus calls for a flexible definition of steps. None of the pilots however saw the step concept in a wider innovation adoption context and preferred to relate the steps concept to personal development goals. Yet the appeal of the small step concept as a whole can be useful for taking away fear of innovation and change by making the new tools less daunting – steps are digested more easily than leaps.

4.2.3 Development

The development concept was the strongest point of our metaphor. The ease of use of the new tool encouraged participants, including students, to engage further: not only were they interested in using the same tool in the future, but a significant number of students, about every eighth, spontaneously used other Google Docs or similar applications.

However, pilot leaders and, to a lesser degree, other participants expressed the desire to be shown how the technology can be used to help them in new ways. This emphasizes the need for staff in learning technology or learning and teaching support roles. The time investment from such staff need not be high and can certainly be streamlined by running group sessions or producing best practice examples, but the availability of staff who understand lecturer needs, can suggest solutions and provide inspiration is crucial.

4.2.4 Institutional integration

The issue of institutional integration uncovered some strong opinions. Three pilot leaders, only one of them with more advanced technical skills, reported that institutionally provided tools were sometimes not appropriate for the tasks at hand, and they occasionally infringed institutional policies to access tools that met their needs. Such behaviour puts institutions under pressure to provide services that meet the purpose and to regularly review their policies in order to balance the needs of staff with technological requirements which can be perceived as restrictive.

Overall, the use of Google Docs was in line with institutional policies. One of the main issues was the availability of support: for the duration of the project, our team provided ample support to staff and students. Support beyond the project, though, depended on the willingness of technical support staff or learning technologists, with the exception of one institution, which was in the process of adopting Google Apps across the whole organisation. For this institution, our project provided the first step towards a full roll-out of the Google Docs component.

Pilot G went a different route and implemented Google Apps as a department initiative for 90 staff members. The take-up was swift and healthy, even though sustainable support has not been implemented into the departmental plan to date. Yet low administrative requirements, exemption from product charges as an educational institution, and the ease of use of the technology helped this department establish a collaborative research environment service that is now used on a regular basis, thus providing evidence that some adoptions of modern cloud-based technologies, where application services are hosted on external as opposed to institutional servers, can be realised on a small scale, complementing core institutional services.

5. Conclusion

This study provided insights into some of the factors affecting early stages of an adoption process, which focused on Google Docs as an example of web-based collaborative tools. Based on a synthesis of literature on individual-based adoption models, the project team developed its own STAIRS framework to guide users taking the first step of engaging with an innovation. Specific aspects of the framework focused on skill development, use of an appropriate tool for the task at hand, and realising the benefits of collaboration to not only enhance learning, but improving processes in general.

Overall, the users of the technology were very satisfied with most aspects of their use, leading to one actual adoption at an institutional level, one adoption at a departmental level, and individual pockets of continual use, although this use was outside of institutional contexts. The successful use of the innovation with only minor technical issues also prompted the wish of further engagement with this and similar tools.

The STAIRS framework provided generally adequate guidance, although some of the concepts were not relevant to end users. While some of the original ideas had to be rejected, there does appear to be a modified STAIRS framework that can be applied and used for future projects. This suggests that a specific technology champion is required as support person to help projects select the technologies they need (the first step), which in turn allows the desired collaboration to occur (a natural step). An important elaboration of this would be the addition of a second step to address individually defined desired outcomes, and that is a pedagogical step which allows the collaborative technologies to be used in the right way.

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Out there and in here: design for blended scientific inquiry learning

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One of the benefits of mobile technologies is to combine 'the digital' (e.g., data, information, photos) with 'field' experiences in novel ways that are contextualized by people's current located activities. However, often cost, mobility disabilities and time exclude students from engaging in such peripatetic experiences. The Out There and In Here project, is exploring a combination of mobile and tabletop technologies in support for collaborative learning. A system is being developed for synchronous collaboration between geology students in the field and peers at an indoor location. The overarching goal of this research is to develop technologies that support people working together in a suitable manner for their locations. There are two OTIH project research threads .The first deals with disabled learner access issues: these complex issues are being reviewed in subsequent evaluations and publications. This paper will deal with issues of technology supported learning design for remote and co-located science learners. Several stakeholder evaluations and two field trials have reviewed two research questions:

1. What will enhance the learning experience for those in the field and laboratory?
2. How can learning trajectories and appropriate technologies be designed to support equitable co-located and remote learning collaboration?

This paper focuses on describing the iterative linked development of technologies and scientific inquiry pedagogy. Two stages within the research project are presented. The 1st stage details several pilot studies over 3 years with 21 student participants in synchronous collaborations with traditional technology and pedagogical models. Findings revealed that this was an engaging and useful experience although issues of equity in collaboration needed further research. The 2nd stage, in this project, has been to evaluate data from over 25 stakeholders (academics, learning and technology designers) to develop pervasive ambient technological solutions supporting orchestration of mixed levels of pedagogy (i.e. abstract synthesis to specific investigation). Middleware between tabletop 'surface' technologies and mobile devices are being designed with Microsoft and OOKL (a mobile software company) to support these developments. Initial findings reveal issues around equity, ownership and professional identity.

Keywords: *mobile devices, design, distance learning, scientific inquiry, changing environments, access, tabletop systems*

1. Introduction

Educational experiences can occur in a wide variety of locations such as museum visits, theatrical attendance, work-placements and field trips (Lonsdale et al., 2004; Hall et al., 2005, Adams et al., 2005). In this project, our approach is to design hybrid learning experiences supported by a combination of new technologies. The underling idea is to link students in the field with others situated indoors, supporting a diverse set of learning activities. Elkins & Elkins (2007) identify the cognitive gain of fieldwork by linking theory into practice and translating 2D 'knowledge' into 3D (and even 4D with time) 'understanding'. Collaboration within field studies can also support student identity formation through communities of practice (Wenger, 1998). Through collaboration between both parties, some of the benefits of field activities can be achieved by students who are not physically 'Out There', while those students can be supported by their 'In Here' collaborators. An inspirational analogy is the 'Treasure Hunt' TV game show, where studio-based participants guided a, 'skyrunner' over a voice link, searching for clues to lead them to their next location. We propose that having students work together in this interactional way offers new opportunities to synchronously combine field data gathering with research, analysis and reflection. As well as involving students who are unable to go to the site, it can enable more of the inquiry process to happen there and then, rather than field-based students having to hold back on analysis until a later date, away from the actual location

2. Background

Geoscience education emphasises the value of supporting students to develop their expert roles, transferable skills and confidence through collaborative fieldwork (Petcovic & Libarkin, 2007). Mobile technologies can be designed to enrich these 'situated learning' experiences through increased situated data collection, information access and co-located synchronous sharing. Unfortunately, for some, access to such experiences 'in the field' may be limited by disability, cost or timetable. Scanlon et al (2004) argue that students with disabilities are under-represented in higher education science and engineering. It has been identified that remote experimentation can play a key role in increasing accessibility for practical work and experiential learning. However, this work has largely focused on students working in isolation. As collaboration is often a key part of professional learning, this research has sought to uncover how technology can support situated learning experiences through synchronous collaborations that are co-located and at a distance.

The importance of scaffolding for technology enhanced inquiry learning within different contexts is well established in the literature (Rogers et al 2006; Manlove et al, 2006). However, the impact of scaffolding collaborative inquiry-based activities between multiple locations mediated by technology is poorly understood. Moreover, many learners are excluded from field-based collaborations because of physical, economic or social reasons. We suggest that social learning theories ('boundary objects' in particular) are a useful starting point for developing engaging yet applicable technology-mediated scripts to enable co-located and separated group inquiries.

Over recent years there has been an increase in innovative technological approaches to learning in informal and formal field-based situations (e.g. Rogers et al., 2002, Hsi 2003; Lonsdale et al., 2004; Hall et al., 2005, Adams et al., 2005). Some of the questions exposed are being reviewed by previous research on personal scripted-inquiry learning in the 11-14 year group (Collins, T. et al, 2008) and field visualization (Teves, R., 2007). Few of these, however, relate to science learning in higher education (HE) contexts. This project is building on this knowledge base and others to develop inquiry-based activities and visualizations for HE science-based contexts. An increasingly important part of inquiry-based activities is the learner's role and interactions within a relevant community. Latour (1999) talks about this knowledge acquisition as a 'complex process of fabrication and negotiation'. Tuomi-Grohn and Engestrom (2003) argue that it is not knowledge that we are required to transfer from situation to situation but 'patterns of participatory process'. What is agreed between theories, and is a main focus for this research, is the often overlooked importance of collaboration in inquiry-based learning.

In certain communities, collaboration in field-based inquiry is a fundamental part of practice and, accordingly, involvement in field activities makes a significant input to the emerging practitioner identity of the student. However, participation in field work may be circumscribed by issues such as cost, physical access and safety which pose problems in field-based collaboration for some or all students. It is a primary objective of this project to enable equitable inclusion of all learners. To achieve this objective we must review many complicated psycho-social issues surrounding a student's perceived participation within a community.

It is important to understand the role of psycho-social elements in learning. However, it is often cognitive rather than affective issues that are the focus of evaluations. Shulman (2004) argues that emotions are a key element in practice-based learning, with collaboration as the route to overcoming near impossible professional challenges. Some emotions, it is argued, such as anxiety and discouragement (for some closely linked to technology) can be overcome through a collaborative sense of belonging, trust and support. To feel part of a community requires a joint understanding of certain concepts and norms (e.g. roles, relationships, ownership, participation, negotiation, goals). All of these concepts have associated perceived affective connotations relating to levels of participation (e.g. respect, rejection, appreciation, inspiration, deterrent, expectation, reliance, confidence).

This research project uses as a starting point Lave and Wenger's theory (1991) of 'legitimate peripheral participation' and their identification of 'communities of practice'. The theory details how new members are brought into knowledge communities, and how knowledge communities both transform and reproduce

themselves. This participation is at first peripheral, but gradually increases in both engagement and complexity. They go on to argue that the emphasis within learning should be on the whole person, and that learning involves equally the agent, activity and world. Wenger (1999) extends this to a framework in which the two basic streams are *Practice* (from collective social norms of practice to accounts of meanings) and *Identity* (from impacts of organizational power and social structures to those of personal subjectivity). Supporting communities of practice can assist the development of effective ways in sharing knowledge across organizational and situational boundaries, thus promoting collaboration and coordination while also increasing productivity and overall performance (Adams et al, 2005; Millen et al, 2002; Mojta, 2002). However, we also need to understand how disadvantaged groups are pedagogically supported to have equitable interactions within those communities (Shulman, 2004)

Current research into HE elearning communities and their moderation (Preece, 2000; Salmon, 2000), although conceptually rich, focuses on the online context. This project is utilising these knowledge bases and building upon them for the learner transferring between online and offline contexts. Supporting a learner transferring between situations is often left to poorly developed aids (e.g. books, manuals, technology). These items or 'boundary objects' act as an interface between boundaries of domain knowledge and organisational structures (Star and Griesemer, 1989). Boundary objects are often defined as physical artefacts (e.g. technologies, whiteboards) but they may also be 'stuff and things, tools, artefacts and techniques, and ideas, stories and memories' (Bowker and Star, 2000 p. 298). Scripted learning activities, as well as the devices that support them, could equally be considered boundary objects as they move through social networks and communities, playing different roles in different contexts. Mapping boundary object transitions between different community actors can often reflect underlying affective responses, social norms and structures that impact upon learning. Technology is often envisaged and used as a boundary object to support learning within and between communities. However, an understanding of HE learners' affective, cognitive and social perceptions of inquiry-based learning technologies is poorly researched. This project seeks to codify and understand these factors within the context of scripted inquiry-based activities.

Within the technical domain the concept of boundary objects has been encapsulated within the concepts of 'shareability'. There have been some innovative technical developments and evaluations in the field of shareability. Hornecker et al (2007) detail a model for understanding shareability based on entry points (design features inviting interaction) and access points (design characteristics enabling collaboration). This model provides a valuable technical perspective on supporting the design of co-located shareability but doesn't relate this to psycho-social elements of collaboration or learning design. This project will seek to build on this knowledge and fill the gap identified.

Many of the starting points for shareability relate to issues of information 'visualisation'. There is a wealth of research into visualisation; its impact on different types of information (Benford et al, 1999), on cognitive functioning and thus learning (Card et al, 1999; Beale et al, 2006). Visualisations of geological information have tended to concentrate on maps. There is, however, a wealth of geological digital resources to which learners need to relate this information. The Delesse project for the NSF was a large scale US based digital library for the earth sciences. The geoscience digital library project (GDL), in particular, highlighted the role of community engagement with the project. However, research is needed into the integrating of these resources and others through visualisations that are both engaging yet support cognition and collaborative investigations. These objectives are a main focus of this research project.

Finally, Church et al (2006) highlight how co-located collaboration through a table-top facilitated collaborative decision-making for a simple design task. Rogers et al (2006), however, have demonstrated a problem of poor awareness for remote participants in a co-located and remote collaboration activity (i.e. designing a garden). Their research reinforced the need to scaffold learning activities. We are using a scripted learning approach which is well suited to scaffolding within scientific inquiry (Manlove et al, 2006). O'Donnell and Dansereau (1992) and Dillenbourg (2002) have identified the potential to scaffold learning while allowing for personal exploration. However, the development of this approach to collaborative exploration requires further investigation and is a key aim of this project.

3. Studies

A number of user studies with traditional mobile to PC based technologies have been completed. The findings from these studies have been fed into current research development using ubiquitous technologies (e.g. Tabletops, sensors, mapping technology) to support distributed activities that are monitored, logged and analysed.

3.1 Research rationale

Our approach is to support collaborative remote experimentation where students work together across different contexts (Rogers et al, 2009; Hornecker et al, 2007; Koleva et al, 2001; Benford et al, 2009). Two high-level research questions are guiding these studies:

1. What will enhance the learning experience for those in the field and laboratory?
2. How can learning trajectories and appropriate technologies be designed to support equitable co-located and remote learning collaboration?

Of importance in developing these systems is the notion of 'shareability'. By this is meant technologies that are designed specifically for more than one person to use at a time, and in so being used can enable groups to collaborate more effectively. In sum, the project involves:

- Interface design for temporal and spatial issues in co-located and remote collaboration.
- Visualisations to support integration of multimedia data from multiple sources on different platforms, input and output devices (i.e. mobile, table-tops)
- Orchestrating distributed interactions to enable equitable co-located and remote data sharing
- Graceful degradation if and when network problems occur (e.g. lost video links to the team automatically replaced with audio or textual communication).

3.2 Stage 1: Remote to lab-based collaborative learning

The domain in which we have been designing technology enhance learning system is geology where students visit quarries to examine aspects of the earth, e.g., rocks, fossils, minerals, sedimentary layers. Geologists undertake a range of tasks within a geological or environmental investigation (for example, planning, observing, field identification, sketching, measuring, mapping, data collection and recording, finding information in secondary sources, data analysis, interpretation, drawing conclusions and reporting) and students need to understand the methods of acquiring, interpreting and analysing information alongside a critical understanding of the appropriate contexts for their use. One of the key skills involves collecting and integrating several lines of evidence to formulate and test hypotheses. This involves making connections between information which is often situated in different contexts. The integration of fieldwork, experimental and theoretical investigations is therefore vital to the learning experience. Pilot studies have already been completed with groups of undergraduate students and potential adopters (i.e. HEIs & technical developers) for a number of geology field sites (Gaved et al, 2008). In the first pilot study a co-located field helper and a disabled student took part. The initial system was built using a Wi-Fi network that allowed transmission of data from the field to the student by the roadside. These were loaded onto a field laptop running a web server that could be viewed and downloaded synchronously by the student and their supporting tutor, for analysis. In the second pilot study, student teams on location at the geology field site separately and jointly collected, recorded and synthesised geological data which was then remotely shared with home-based students at the University who debated, synthesised and provided data from other sources e.g. internet, textbooks. In this study the field location and the laboratory were separated by several kilometres. This required a more extended network infrastructure to support synchronous remote synthesis of the data collected and analysed. Subsequent studies utilised VOIP (Voice Over Internet Protocol) handsets with wireless network routers configured as a dynamic mesh network, designed to pick up their nearest neighbour and automatically route the signal forwards.

The findings from the two studies showed that students were able to collaborate effectively. The implications from the remote access trials are that mobility impaired students are empowered through having remote

access to field locations and can complete the practical aspects of geology fieldwork. Moreover, engagement with the technology allowing remote analysis of data was perceived as providing an educationally beneficial experience. Ultimately although a remote experience cannot replace a field-based experience, it can provide an additional experience to those at both locations.

3.3 Stage 2: Analysis and ubiquitous technology development

The project aims to explore issues around geological field trip learning that is 'replicated' for students who are not physically 'Out There'. This requires being sensitive to the experiences of both classes of students and their instructors. As a starting point it is necessary to understand the benefits of field trip experiences, so we have begun a process of eliciting qualitative data from stakeholders (geologists, students, academics) on this topic.

Two activities collected stakeholder perceptions; a set of reflective posters situated in a student / academic common room. These asked for responses to the following questions: 1) *"What is it about real fieldwork that makes it such a great learning experience?"* 2) *"What do students NEED to learn in the field?"* 3) *"What can students ONLY learn in the field?"*. The data from this revealed 39 threads for analysis. The second research activity comprised of a day long workshop with 24 stakeholders around field-based learning concepts. Responses from both activities were thematically analysed into these threads:

- Social and collaborative learning (e.g. *"People, peers, discussion, combined learning journey"*)
- Immersion in the subject (*"Concentrated. Progression of thought is focussed without distraction"*)
- Scale (*"Context –from hand-lens scale to landscape scale"*)
- Senses (*"All senses come into play (smell / feel)"*)
- Seeing in reality (*"It's different imagining rocks from books and pictures than seeing them in real life"*)
- Reality is complex, and not like the textbook (*"That there's no such thing as a perfect example of a rock type"*).
- Learning the process from observation through analysis (*"How to build up a 'story' from lots of observations"*).
- 3-Dimensional Comprehension (*"Relationships between hand sample, outcrop-scale and terrain scale"*).
- Essential practical skills like mapping, measurement and reporting (*"How to locate features seen on a map in the real world and how to put observations onto a map"*).

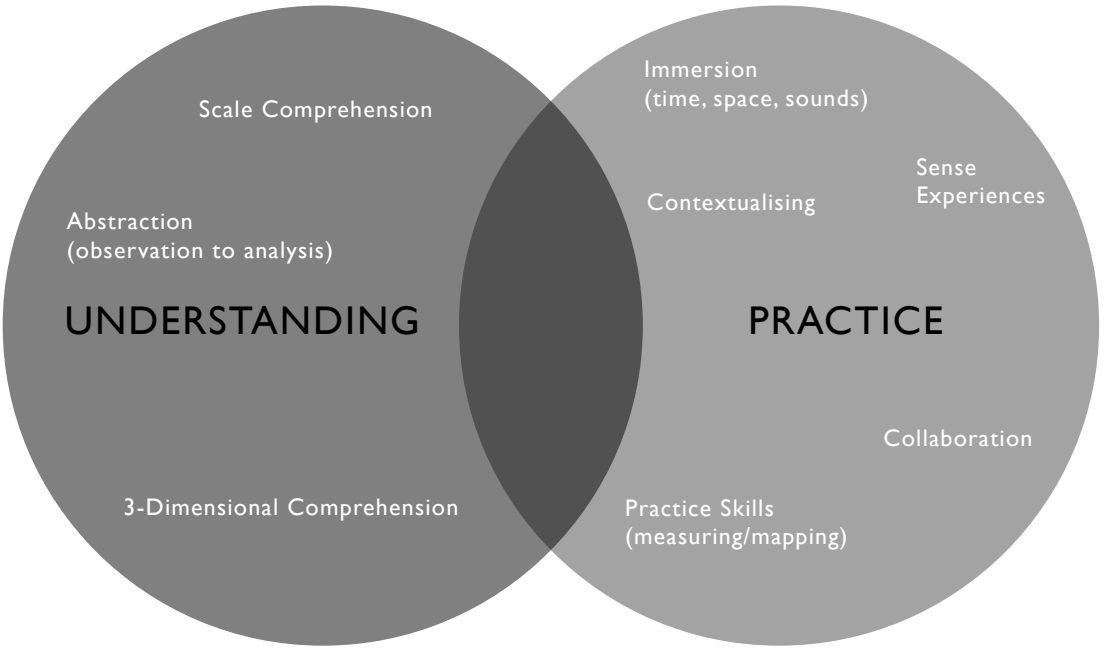

Figure 1. Geologists perceptions of field learning benefits

Figure 1 presents a high-level abstraction of these themes and shows how the benefits of fieldwork can be seen in terms of improved understanding and development of practical skills. Supplemental student learning materials (e.g. fieldwork videos with analyses and conclusions) have also been analysed and fed into an initial model of the experience essentials. Workshops and interviews are being undertaken to develop this understanding further, leading to a detailed set of initial requirements for the system and for complementary activities.

The initial trials have identified that a crucial element of the design process is the importance of technology being led by pedagogical and students' socio-psychological needs. An example summary of a scripted inquiry (see table 1) that has been edited and summarised from the second pilot study illustrates the development of the pedagogy for the next stage of technology development.

Stage	Scripting components	Description
1	Study aim	Interpretation of the past environment through an investigation of the current geological features in a sand quarry.
2	Collaborative Activities	Students are placed into 3 teams to investigate different aspects of the geological evidence: a) palaeontology, b) graphic logging and c) mineralogy and palaeocurrents.
3	Collaborative Procedure	Half the members of each team go into the field and half remain at the 'home-base'. Teams are in communication via audio and video and can exchange digital images.
4	Collaborative pedagogy	Lab and field members of the three teams have scripts (i.e. detailed objectives, stages in the activities, learner role descriptions and assignments, interlinking tool usage) which guide them through a joint investigation with each half of the team using the relevant techniques and tools for the two locations; Lab (e.g. textbooks, identification books and charts, maps, geology software and internet resources) and field (e.g. measuring tapes, trowels, hand lenses, grain size cards, compass clinometers and GPS handsets). Both teams have interlinked tasks requiring communication, collaboration and co-ordination between sites to complete the investigation. Collaborative documents are used to focus on hypothesis generation with evidence e.g. by making and adding to a field sketch and joint voting activities. Throughout the study all the participants debate findings and interpretations, in a group discussion which is mediated by the tutors. Each participant provides information which is then integrated into a shared representation to describe the whole picture. A field and lab tutors will support investigations.
5	Evaluation	Summer 2010: Two field trials will be video recorded, collaboration logs recorded and participants interviewed. Resultant quantitative and qualitative data will be thematically analyzed.

Table 1. Scripted Scientific Learning for Geological site trials (technology enhanced learning)*

The implications from the remote access trials are that mobility impaired students are empowered through having remote access to field locations and can complete the practical aspects of geology fieldwork. Moreover, engagement with the technology allowing remote analysis of data was perceived as providing an educationally beneficial experience.

A user-centered participatory design approach is being employed for the design and development of this technology enhanced learning system (Muller, 1991; Kiili, 2006). System requirements (i.e. functional and non-functional requirements) have been gathered from user trials (initially from the project pilots) and from participant design meetings with end-users (e.g. students and teachers), discipline experts and stakeholders (e.g. geology academics, technology developers, HCI and elearning experts). These design meetings are enabling interdisciplinary participation in the project throughout its life as the system is iteratively developed, evaluated and re-developed.

The findings from the 1st stage research have led initial design decisions to be based on the importance of a distributed interdependency. The next stage of prototyping proposes to develop new ways of connecting those excluded from participating in outdoors activities with those included, providing enjoyable and equitable roles for all. To this end table-tops and innovative mobile devices will be linked though middleware that has the goal of supporting distributed mixed teams to work together cooperatively. In order for students in the field to progress they need to communicate with and follow suggestions made by students at the home station who use the tabletop. Evaluations are focusing on the benefits and limitations of technology-interlinked with socially interdependent experiences. To aid communication we plan to provide two-way audio and video links enabling participants to talk with one another during their data collection/ manipulation activities (see Figure 2).

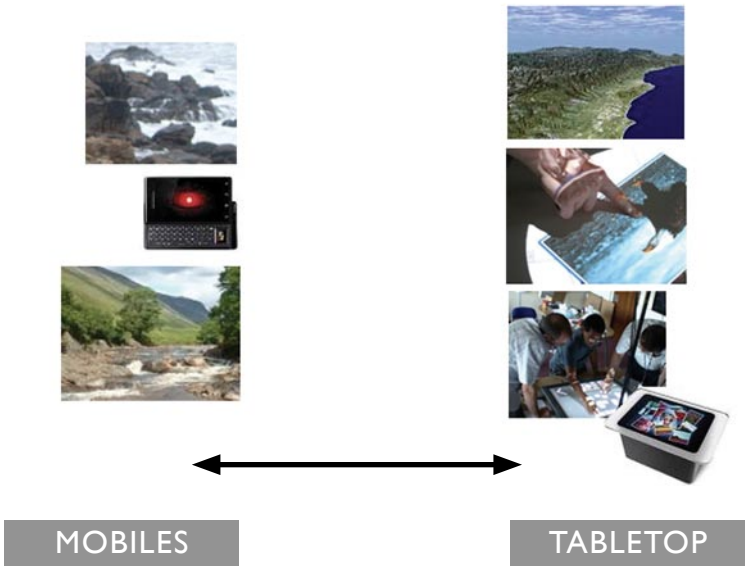

Figure 2. Mobiles and tabletops supporting collaboration and situated learning.

4. Conclusion

The findings to date highlight the value of technology supported distributed collaboration. However, we need to understand better the complex issues of equity in those collaborations. Co-located collaboration in a traditional indoor setting can produce problems with equitable teamwork and shared inputs (Rogers & Price, 2008). Collaboration between distributed teams is likely to increase the inequality of these collaborations. Orchestration of activities and interactions is therefore central. Koleva et al (2001) initially detailed the concept of 'orchestrating' a mixed reality performance where performers orchestrated players' engagement in an interactive experience. They argued that the key factors within orchestration could be utilised in workplace technologies. Benford et al (2009) took these findings further with studies looking at interactional trajectories for tangible interfaces in museums and galleries. Trajectories provide designers with a heuristic to support collaborative experiences over space and time involving multiple roles and interfaces. The current and future research plans of this project are to use the trajectory framework to design the collaborative learning experiences across technologies and locations. These will include determining the timing of interactions, individual roles to encourage collaborative support, different forms of communication for different spaces, establishing appropriate participant expectations and if intervention is needed. The role of a teacher and the student in this trajectory is also paramount. However, a key issue which keeps reoccurring throughout the project is the importance of our understanding of how learning fits with the development of professional skills and identity. The importance, yet complexity, of these issues within technology enhanced learning developments are something that researchers, practitioners and policy makers must understand for future system developments.

5. Acknowledgements

We would like to thank the EPSRC / ESRC for their support of this project through the 'Digital Economy' programme.

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Can student use of Flip camcorders enhance learning with large cohorts?

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This case study addresses the challenge of how students in large, diverse classes can become effectively engaged in their learning through the support of Flip camcorders. It describes two phases in the implementation of a first year module (Theory of Management) in the University of Exeter Business School. Each phase has been important in coming to understand the complexities and difficulties of the pedagogic processes and those relating to technology use. Overall, a total of 440 students, half of whom are international, have been involved in using Flip camcorders to video their own group presentations, and to watch and learn from the videoed presentations of others. Data on student outcomes and perceptions have been collected through ongoing monitoring, individual and group reflective accounts, focus groups, tutor and student-led surveys, and informal verbal feedback. A growing element of the module has been a small number of students taking a leadership role in being responsible for the management of Flip camcorder use, in order to support the ever-increasing student numbers. Overall, the use of Flip camcorders is highly valued by most students and by the tutor, despite the many unexpected difficulties associated with their management and with finding an appropriate space to store large amounts of video for review. The main benefits are in the way that they can be used to support attendance, group cohesion and quality of work, in an ethos where the importance of group work is central and where individuals are recognised for what they can contribute despite the large cohort size and the many different nationalities involved.

Keywords: *OER, open educational resources, open license, open education, IPR, responding to change, HEA, JISC, reusability*

1. Introduction to Flip camcorders

Video has long been used as a tool for teaching in higher education and there are now many resources from sites such as the British Universities Film and Video Council, the BBC, and Youtube. As is highlighted by the JISC (2009) in their video guidelines, *'Audiovisual material provides a rich medium for teaching and learning'*. Yet viewing video may be a passive experience, especially if no interactive elements are introduced (Thorpe and Williams, 2009). When students make their own videos, they are clearly more actively engaged in learning, but traditional video techniques have meant that technical problems abound with, for example, a lack of similar equipment for all students, a lack of technical expertise, and a *'disparate array of finished media that is often difficult to view, assess, and compile into a cohesive project'* (Campbell et al, 2009).

More recently, however, those with little or no technical expertise have been able to make their own videos due to the advent of relatively inexpensive camcorders. Amongst these is the Flip camcorder - not much larger than a mobile phone, with a 2GB flash drive that can store up to 60 minutes of video. Beaumont (2008) writes: *'It's just a basic camcorder, but the Flip has captured the imaginations of millions... Not bad for a gadget that costs less than an iPod and that looks like it's been designed by a child'*. She quotes Jonathan Kaplan, chief executive of the company behind the Flip: *'The goal of the Flip is to make video fun and easy, so that you actually do something with your footage'*. This is a major reason why such a camera is of interest: video can be instantly downloaded to a computer via a USB port, and software is stored on the camcorder, allowing easy editing and uploading.

Jake Dunagan, research director for the Technology Horizons Program, Institute for the Future, emphasises the changes that video may bring, describing it as: *'a significant avenue for the way young people acquire knowledge'* (in Rowell, 2009). Comments on educational websites in the USA are as enthusiastic as the marketing literature. Wolff (2008) states: *'I have never seen a group of students become so enamoured with a piece of technology'*. The Emerging Technology Applications for Online Learning Symposium site (2009) highlights the potential: *'The results have been phenomenal'*. In addition, Rowell describes three projects from different universities wherein Flip camcorders are reported as both ideal for students who are not technology-savvy, and as having a marked impact on learning. Bottema and Visscher (2009) report on the benefits of Flipcams for reflective portfolios with students in the Netherlands, and Clay (2010) states that in the UK *'hundreds of institutions have run pilots and projects involving these cameras'*; he links to nine positive case studies, mostly from FE Colleges. However, there is little detailed evaluation of Flip camcorder use, and no mention of large student cohorts.

2. A case study of Flip camcorder use

2.1 Research design and aims

This study describes two phases of a 3-phase project on Flip camcorder use with large groups of first-year students following a Theory of Management module in the University of Exeter Business School. The project has fallen naturally into phases, with the module being taught three times in quick succession: the second semester of 2008/09, followed by the first and second semester versions in 2009/10. At the time of writing, Phase 3 is just beginning. Overall, 440 students have been involved, with almost half being international. Phase 1 (86 students) provided an exploratory pilot and pointers for improvement. Evaluation data was collected via ongoing discussion with the tutor and an end of semester student feedback session. Phase 2 (224 students) allowed incorporation of changes and was evaluated in greater detail, with student outcomes and perceptions gained from reflective accounts, focus groups and surveys, including student-led data collection. Phase 3 (130 students) is expected to be the most refined, building on previous learning. These phases have allowed a cyclical process of planning, implementing, monitoring, evaluation and review.

The study has been made possible through involvement in a JISC-funded project within the Curriculum Delivery programme (2008-10). The project (Integrative Technologies) has allowed the offering of support for developments in technology for teaching, and the ongoing monitoring and evaluation of processes and outcomes.

The overall purpose of the study has been to understand the complexities of both the pedagogic and technological processes of Flip camcorder use. The specific aims have been:

1. to review technological, organisational and pedagogic issues in the use of Flip camcorders by students;
2. to ascertain whether, and in what ways, student-led use of Flips can support the development of learning and skills in large and diverse cohorts;
3. to develop and refine practices incrementally as an outcome of evaluation of the three phases, taking note of student feedback on experiences of learning in general and from Flip use in particular;
4. to provide resources and recommendations for future use of Flip camcorders.

3. Phase 1

3.1 Implementation: why Flips?

Within the JISC Curriculum Delivery programme, each project was provided with a Flip camcorder. It had immediate appeal - bright orange, very compact, lightweight, and with an instant computer upload facility, and had potential to fit the aim of the project – to integrate a variety of forms of technology into learning within the Business School. Initially three Flip camcorders were tested and compared for costs, facilities and quality: the standard version provided by the JISC (cost at that time, £79.99), a slightly more expensive mid-range camera (£15 in addition) and an HD version (twice the standard cost). In a pre-pilot trial, each was used to record step-by-step calculations on a whiteboard in a mathematics module, with the expectation

that the video could be used for revision purposes. However, even when using the HD version, the visual quality was not good enough to capture the whiteboard writing.

When the tutor of the Theory of Management module expressed an interest in using Flips for group-work, six camcorders and mini tripods were bought. As teaching sessions had only a one-hour gap between them, good battery life was important (since time for re-charging between sessions would not be possible). Mid-range cameras with re-chargeable lithium ion batteries (recharged via a USB port) were selected for practicality and sustainability.

3.2 The teaching context

The aim of this new Theory of Management module is for first year students to examine the characteristics of organisations and the practice of management. It is well-supported by technology, with online quizzes and video materials available through the core text, an audience response system to promote engagement in lectures, and streaming of lectures for revision and review. Cooperative group work is fundamental, encouraged specifically through tutorial sessions wherein students give group presentations and offer peer feedback. Presentations with groups is not an easy option. As emphasised by Felder and Brent (1996), *'Cooperative learning tends to be the hardest student-centered method'* (often for both students and teacher), a view supported by the Johnson's several decades of research in the USA (see Johnson and Johnson, 2003); yet they also claim that group work can be the most satisfying means of learning, with improved grades and outputs from students. However, viewing student presentations, as with viewing video, can be a highly passive learning experience unless there is an active and challenging audience (Stead, 2004). For this module, an initial formative presentation requires group members *'to convince all the other groups that you are in the best group'* and to be actively engaged through offering feedback to other groups. It is within this context that Flip camcorders fit. Groups video this early experience as well as an academically focused presentation. A reflective account, the presentations, plus a report on skill development and the impact of working collaboratively, contribute 30 percent to the module grade. No editing of video is required, and no judgements are made on the quality of the video.

The module is run by a recently appointed teaching fellow with a broad workplace experience of business and management, and a desire to teach academic content effectively whilst developing strong group relationships. Despite describing herself as a *'technophobe'*, she believes it essential to *'engage with the educational process in a contemporary way'* and for students to develop professional skills that will relate to their future careers as young managers: technology is important since it is embedded within everyday business life, and graduates need to be equipped with appropriate skills. Video was used for four main purposes: i) for each group to review their own presentations in order to improve their skills; ii) to review other group presentations to analyse skills of others; iii) to have available a number of presentations that would enable students to review subject content and learn from each other's contributions; iv) to ensure that every individual is 'visible', since in large cohorts (often in impersonal 350-seat lecture theatres) it is possible to remain 'invisible' throughout a module.

3.3 Video of student presentations

Phase 1 students were split into three tutorial groups and then again into five presentation groups, to give 15 groups. At the start of the first tutorial sessions, a few minutes were used to demonstrate how to operate the camcorders (*on, record start/stop, zoom in/out, off*). Reasons for recording were explained by the tutor, along with the fact that videos were solely available to those registered on the module. Consent for recording was obtained, with the opportunity to opt out (although none did). Two recordings were made of each group's presentation, one at close range so that speakers could be clearly heard and PowerPoint slides captured, and the other from a wider angle to review body language. Overall, the recording, editing and uploading of approximately 12 presentations was required per week. The tutor's feedback session for each tutorial was also captured to emphasise feed-forward, that is, students understanding their presentation marks and learning from others so as to develop their own performance. To display footage, Pinnacle Studio 10 was used for basic editing. Files were converted from .avi (the standard recording format) to .flv, so that they would play instantly within a flash video player embedded into an HTML web-page in WebCT.

3.4 Evaluation

3.4.1 Student and tutor feedback

The impact on the class was greater in some ways than that anticipated. Attendance at videoed sessions ran at 98%, far higher than in many other taught sessions. Initially, student responses to watching video were varied: *'I don't like watching myself in a video'; 'I would prefer others to tell me how I can improve rather than trying to analyse myself'*; or *'I don't mind watching myself, it's quite useful to see the style that you present in. Other people might tell you, but if you can see it, it's better.'* By the end of the semester, almost all of the fifty feedback comments gained were highly positive: *'I think having this available is very handy because it gives the rest of the group a chance to hear what the tutor said about the actual presentation'*. One student who was working 'at a distance' due to a timetable clash, felt actively involved despite not attending. Students claimed that they i) genuinely enjoyed the sessions; ii) did not want to let down their peers, and iii) recognised their attendance could be tracked via video. They watched videos: just for the sake of it, to see themselves and their friends; to learn about their own and their group's presentation styles and skills; and to aid revision. Tracking of videos viewed online was achieved through the VLE, highlighting that access greatly increased during the revision period. Although access does not equate with time on the site or with learning, students reported that the videos had been really helpful for reviewing subject content. The three negative points were that video is unnecessary because students should learn enough from the live session; one student complained at use of technology just for the sake of it, and one about 'excessive and invasive' use of videoing.

The tutor was satisfied that students were becoming *'used to the idea that they are visible to other people. Videoing enables them to look at themselves from other people's perspectives'. Additionally, 'Videoing had a dramatic impact in terms of attendance, behaviour, style and standards. There is never going to be any argument about whether the students were there or not!'*

3.4.2 Technological and organisational issues

In terms of the technology and organisation of Flip use, several issues emerged.

- One of the camcorders 'froze'. From this point onwards, the tutor always carried a 'back up' camera.
- Students did not always concentrate on the videoing. Problems included: not focusing on faces, shaky camerawork, or lack of thought over lighting or sound. This rendered some content unusable.
- Location of teaching was not in the control of the tutor, but presentations videoed within a classroom environment tended to be of better quality than those in a lecture theatre.
- Since the Flips were required for other activities throughout the week, they had to be collected and returned the same day, which was not an effective way of working.
- A major issue was in the failure to anticipate the amount of time and technical support needed. Several hours were required on a weekly basis for editing, converting, embedding and uploading the clips. This was continued through the pilot as it was important that feedback should be gained on a process that worked smoothly from the student point of view, and allowed a fair trial in terms of the pedagogic value of camcorders.
- The basic software available with the Flip was not adequate for the purposes required.
- If batteries are completely depleted, the unit gives the impression that it is defective (i.e. will not switch on, even when charging). The camcorder needs charging for up to an hour before working again.
- There are occasional reliability issues ('losing' time or hiding files).

To move successfully from the pilot, each of the issues above was addressed. Specifically, it was decided that the tutor and students would need to become self-sufficient in using camcorders and uploading videos themselves, if the project were to continue. Management of the module became all the more important when it transpired that three times as many students had signed up for the next semester.

4. Phase 2

4.1 Implementation: Student responsibility for Flip-camcorder use

More detailed training sessions, to raise awareness of basic camera techniques, were provided to the 50 groups in Phase 2. Whilst this positively affected video quality, there were still problems. For example, shooting video on Apple ipod nano devices requires the unit to be rotated 90 degrees (landscape orientation); several students rotated the Flip 90 degrees - somewhat detracting from video output! Additional cameras and tripods were bought for the larger group numbers. A volunteer group of 'champions' took responsibility for managing processes relating to camcorder use: they ensured recordings, and uploaded content to a central website, viewable by all students. However, this led to additional problems, since students cannot upload material to the VLE due to administrator privileges. A variety of alternatives were explored, with four criteria used in selecting an appropriate site.

1. Space constraints and upload limits: space was required for 22 x 10 to 15 minute video clips (11 groups x 2 cameras per group), potentially 5.5 hours of video each week. In data terms, each 15 minute clip = 300mb, so up to 6.6GB storage was required per week.
2. Upload processes and file conversion: avi format recordings had to be both easy to upload to the central system and preferably converted automatically to an easily viewable format.
3. Uploading privileges: it was necessary for individual students to upload video to the chosen platform for all students to view.
4. Privacy of material: access had to be limited to those taking the module, the tutor and administrators.

Several providers were ruled out for failing at least one of the criteria (Youtube, Vimeo, Picasa and Ning) (see Table 1). Facebook's video capability appeared to offer the only service meeting all criteria – despite concerns over privacy in their user agreement.

Service provider	Few space/ upload limits	Easy upload/ file conversion	No uploading privileges	Privacy	Comments
WebCT	/	X	X	/	Converting files to view done manually; requires technical skills/ time consuming; only course leaders can upload material. Comments possible.
Youtube	/	/	/	X	Uploaded videos can be private (only 25 users).
Picasa	X	/	?	?	1GB free storage limit. Difficult to navigate to video section.
Vimeo (basic)	X	/	/	/	500MB per week (raw file) upload limit; wait before conversion process begins.
Vimeo Premium $59.95/ year	X	/	/	/	5GB per week (raw file) upload limit; premium account upload privileges not transferable to student logins.
Ning	X	/	/	/	100MB per video upload limit.
Facebook	/	/	/	/	No apparent space limitations. Popular, implying confidence with user interface.

Table 1. Chart to show video-hosting solutions for student-created content

4.2 Evaluation

4.2.1 Student and tutor feedback

Alongside Flip cameras, the outcomes of group work were also reviewed. If students were using Flips but not learning, then any evaluation of the technology would be less useful. However, the majority of written accounts were rich stories of personal and academic growth, with students showing deep respect for their peers. They wrote about friendships, support from group members, commitment, changes in themselves as people, and about recognition of the power of learning through review.

- *'Helped us to integrate well and transition from six quiet and nervous freshers to six competent, confident and collaborative university students'. (UK student)*
- *'It was an exhilarating experience as it provided us a unique opportunity of looking back and reviewing the mistakes... Despite the difference in culture and language I have been fully supported by all of the group'. (Vietnamese student)*
- *'I have noticed that I am used to learning things mostly from books, but I do understand now that there are things you can learn only from people'. (Lithuanian student)*
- *'My individual studying was highly influenced by the group ... I could not let myself slack because I must be ready for the group work every time'. (Ukrainian student)*
- *'When I was presenting my first presentation, I was too nervous even to make a sound... I am now able to contribute ideas and discuss opinions with them'. (Chinese student)*

A survey - written and administered by some of the video champions - highlighted student views relating specifically to Flip use. Of 161 respondents, 72 percent thought that video recording had been beneficial to them, though 17 percent were undecided and ten percent disagreed. The reasons for appreciating video were varied: 57 percent considered it had been useful for reviewing the content of group projects; half thought it enabled them to improve their presentation skills; 40 percent felt that having video available had allowed them to go over things they had not understood previously; 32 percent considered it had helped them with revision; and 19 percent claimed that video had given them more confidence with presentations.

In qualitative feedback from the survey, students appreciated the flexibility of having video readily available: *'I can go back to the tutorial any time I wanted'*; they found it helpful to learn skills by watching others, *'we get an accurate picture of any unconscious errors that we may make. It also allows us to compare ourselves with the general standard'*; or to *'improve my presentation skills, my posture and my English accent'*; *'Reflection'*, *'revision'* and *'understanding'* were key: *'they are a good way to recap the theories of each case study'* and to *'revise what has been talked about and learn and improve'*. In addition, they are considered 'a good way of ensuring the quality of each presentation, ensuring teams are thoroughly prepared'. A focus group highlighted even more strongly the power of videoing: *'It's the way that making the video binds us together. That doesn't happen in other modules. There's no momentum'; 'Because it's videoed it gives it a lot more importance – you really feel as if you're under pressure'; 'No free-riding because you're on camera'; 'Because you're really worried, the team support each other better and therefore you make better friends'*.

A small number of neutral or critical comments suggested that videoing *'can be distracting if you are the one having to film'*, that *'it would be better if the video cameras were of a higher quality'* and that *'the quality of the filming/sound makes a big difference - I can't concentrate when something is unsteady/badly edited'*. Three students complained at not being able to find the tutorial videos, and one suggested that tutor annotations would allow better choices for viewing.

The tutor reports that this phase had been *'more of a challenge than I thought'*. This was due to the large numbers as well as the technology but, despite the difficulties, she describes the student responses and outcomes as *'stunning'*, recognising that all the benefits evidenced in Phase 1 can be achieved even with large numbers of students, and that student champions can be used to good effect.

4.2 2 Technological and organisational issues

Whereas in Phase 1 most issues surrounded use of camcorders, the second Phase became engulfed in problems associated with uploading and watching video, largely due to the volume of video footage created. Instruction sheets were provided to the student champions, with screenshots of steps to be taken so they could upload all material themselves. The main technical problems concerned three aspects.

- Uploading video was not straightforward; any recordings longer than two minutes had to be converted to another format (for example .mpg, by using free software) before uploading.
- Additionally, the 20-minute maximum video length meant that some footage could not be uploaded if files were too long; splitting files into shorter sections did not resolve this.
- In some respects, the use of Facebook was a retrograde step since recordings could not be labelled or tagged, as previously done in the VLE.

Overall, the hoped-for savings in staff time were largely not achieved due to such problems. However, student champions did enable the process to run more smoothly than might otherwise have been expected; they understood that new technology can be difficult, were drawn into serious conversations about how processes could be improved, and usually managed to get their videos uploaded. In total, 130 students used the private Facebook group, although in the absence of a counter it is not possible to know how many videos were actually watched.

5. Phase 3

Phase 3 is just starting, and is disappointing in that the uploading problems have not been satisfactorily resolved. A second 'champions' group will be set up, and a smaller class size will be more manageable. Although students will be encouraged to upload video to Facebook, this has been too great a struggle to maintain formally in terms of support time, as well as less positive for students given the lack of potential for labelling. A small number of videos will be uploaded to the VLE, to illustrate both the best and the less good presentations. The pressure will remain on students to video their group since one or two videos will be selected from each tutorial session for uploading to the VLE, so that all groups are covered over the course of the module.

6. Discussion and conclusions

So what does this account tell us about the role of Flip camcorders in learning? In many ways, much of the learning reported could have happened without them, especially in a well-managed group context. However, the evidence that videoing has an impact on attendance, behaviours and group relations is important, as is students reporting they take greater care of style and standards in presentations because they are captured on video. Further, students were able to use the video clips to support subject understanding and revision and to improve their skills and confidence in presentation. Hence both the process (of videoing) and the product (the video) played a part in the success of the learners, in a way that would not have been achievable without the usability of Flips.

Student champions suggested that the tutor should take examples of the best and least good videos and record comments as a voice-over commentary, picking out aspects of body language and presentation skills, and the tutor has agreed to do this. Many students are keen that Flip cameras should be used more often, either formally or informally; one student reports recording a presentation in a different module, where Flips are not being used, and this student-led behaviour may pave the way for expanding use of video. The technological problems may take a while to resolve satisfactorily, especially with regard to viewing large numbers of videos, but the possible advent of institutional video storage space may help in this respect. The learning from each stage of the project will be used to provide guides for Flip camcorder practice in the future, and it is anticipated that the collaborative process between lecturer and student champions will continue, with current students mentoring next year's first-year module intake.

Flip camcorders can be used in so many ways, even if their use is not quite as simple as the marketing suggests. Flip video is a powerful and relatively inexpensive tool for teachers to provide a visual element to student study, and could be equally powerful for qualitative research. Several JISC-funded research projects (e.g. STROLL: Jefferies et al, 2009; LEaD: Hardy et al, 2009) have explored perceptions through the use of learner video diaries. Flip camcorders would make this kind of approach simple, enabling rich pictures of student life to be gained quickly and easily. With student-made video, greater focus could be placed on the content and quality of video than in this study, with editing and technical skills being an essential part of the learning process. Above all, student-created video can be used in numerous ways to give opportunities for student review and reflection, which are at the heart of the learning process; and this becomes instantly possible through the medium of a Flip camcorder. At Exeter, as in other institutions, students are currently making short Flip videos to illustrate aspects of student life, activities and events, for marketing and information purposes. International students are making video to illustrate their home backgrounds so that their peers can understand more of the cultural richness of study in a multi-national context. Indeed, the role for the Flip camcorder seems to be endless, and one that deserves continued exploration and evaluation. In the words of one student from this study: *'keep going with the videos - we want them!'*

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Hybrid professional learning networks for knowledge workers: educational theory inspiring new practices

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Knowledge workers need to acquire new knowledge and competences at an ever-increasing pace due to the fast changes in today's knowledge society. In addition, new (online) technologies revolutionise the way we communicate, learn and work. They trigger structural changes in the context and nature of professional work.

For knowledge workers such as journalists, librarians or product designers it is not only the tools with which they work that change. Structural changes also affect the core of their profession, since ubiquitous information, delivered via new media, is readily available any time any place. Traditional professional learning cannot cope with these changes. Hence, new ways of professional learning are needed.

The question we need to answer is how to address the specific learning needs of knowledge professionals. Experience shows that these needs are not sufficiently met by existing learning technologies, neither by institutional (virtual) managed learning environments (MLE) nor by Web 2.0 based personal environments (PLE). Both approaches have crucial shortcomings for the highly contextualised teamwork of knowledge professionals. Hence this paper introduces the concept of hybrid professional learning networks as combining the best of both worlds, by offering manageable open flexibility and connectivity along with the safety and control that matches the professional knowledge workers' needs.

Keywords: *work based VLEs, learning, informal learning, online communities, social networking, Web 2.0*

1. Introduction

In this introduction, we situate our research and development work by defining the major concepts that we will deal with and we introduce the focus of our study. In the second section we expand on technological systems that are currently used to support professional learning. In the third section we introduce the concept of hybrid professional learning networks as a way to combine the strengths of existing learning support systems. We conclude by briefly outlining future lines of research.

1.1 Continuous professional learning

In this paper we discuss situations of (continuous) professional learning (PL). Interestingly enough, a search of official educational thesauri by Verjans (2010) reveals that the term 'professional learning' does not occur in thesauri such as the VOCED thesaurus (NCVER 2008) or the ETT (CEDEFOP 2007). We conceive professional learning (PL) as being different from professional development (PD). A recent literature review (Webster-Wright 2009) shows that whereas the term PD is mainly related to knowledge that is 'delivered' to professionals by 'experts' in programs, the term PL more often refers to learning activities initiated and performed by the learner. We define (continuous) professional learning as learning initiated and performed by individuals in relation to their professional, i.e. work-related, activities. In our definition, professional learning is not limited to a specific time or place, i.e. it can happen in preparation for, during, or after professional activities, and it is not limited to a single location, i.e. it can take place in the workplace, at home, during a conference or in training session. "Professionals learn, in a way that shapes their practice, from a diverse range of activities, from formal PD programs, through interaction with work colleagues, to experiences outside work, in differing combinations and permutations of experiences." (Webster-Wright 2009, 705) This definition of continuous professional learning therefore encompasses aspects of community-based learning, workplace learning and professional education. (Brown & Duguid, 2000)

1.2 Knowledge worker

Interestingly enough, the term 'knowledge worker' has no officially agreed definition either (Brinkley et al. 2009). The term is said to be coined by Peter Drucker (Drucker, 1957), and is commonly defined in dictionaries as "someone who works for an organisation who is valuable to it because of the knowledge and ideas that they have" (knowledge worker, n.d.) Following Thomas Davenport (Hammer, Leonard & Davenport, 2004) we will use the term to refer to people "with high levels of education and expertise whose primary task is the creation, distribution or application of knowledge" and who use their knowledge for the benefit of the organisation of which they are a member. In our current knowledge society, the speed at which information and knowledge increases is astounding. In 2003 it was estimated that the amount of information created doubles every three years (Lyman & Varian 2003), which implies that knowledge workers continuously need to update their knowledge and skills to cope with their fast-changing environment (Bitter-Rijpkema et al. 2006).

1.3 Networked learning

The increasing speed of information and knowledge creation has important implications for the professional learning of knowledge workers, which traditionally consisted of knowledge sharing through courses, training sessions or workshops. New - complementary - ways of learning are now needed, partly because the developers and providers of traditional professional learning materials and activities cannot cope with the speed at which relevant knowledge changes. Moreover, due to the large amount of relevant knowledge and the need for in depth specialisation within a professional domain, a single person can no longer act as 'the' expert within that domain. Notions such as distributed expertise (Brown et al. 1993, Pillay & McCrindle 2005) or distributed cognition (e.g. Hutchins 1996, Salomon 1993) have been suggested to capture the concept of professional knowledge and expertise as distributed across multiple people, artefacts, communities and organisations. When performing complex tasks, individual knowledge workers need access to other professionals and/or resources within their domain in order to increase their own level of knowledge. Previously, such expert-to-peer and peer-to-peer networked learning arrangements were limited to face-to-face workshops, colloquia or training sessions. Nowadays, such professional networked learning arrangements - often referred to as Communities of Practice or CoPs (Amin & Roberts 2008; Buffum & Hinman 2006; Lave & Wenger 1991; Hildreth & Kimble 2004; Minna et al 2009) - are becoming more and more virtual in nature, as they make increasing use of online collaboration technologies. The typical nature of (online) CoPs is that they are often fairly closed, members-only type organisations that tend to focus on sharing (external) knowledge internally in the community (Amin & Roberts 2008). In this article, we define networked learning as "learning in which [ICT] is used to promote connections: between one learner and other learners, between learners and tutors; between a learning community and its learning resources." (Jones & Steeples 2002, p. 2) Networked learning is based on the assumption that learning mostly happens within individuals: by making connections, learners increase their own knowledge.

1.4 Connectivist learning

An extreme conceptualisation of networked professional learning is voiced in the tenets of connectivist learning (Siemens 2005; Downes 2005), a fairly recent learning theory. Siemens (2005) states that "Chaos is a new reality for knowledge workers" and quotes Karen Stephenson as saying: "Experience has long been considered the best teacher of knowledge. Since we cannot experience everything, other people's experiences, and hence other people, become the surrogate for knowledge. 'I store my knowledge in my friends' is an axiom for collecting knowledge through collecting people (undated)." Connectivist learning centres on the concept of a network of nodes (individuals, but also information, data, images, etc.) and the connections between the nodes, which can differ in strength. Learning is the process of creating connections and developing a network, thereby making use of the expanding online network of information and connections. Connectivism also impacts on the design of learning environments (Siemens 2005). The Internet-savvy knowledge workers have been quick to build their PLE or personal learning environment (Wilson, 2005), making combined use of institutionally-managed learning environments, publically available web-based sources and tools and online social networks to meet their learning needs (Attwell 2007; Downes 2005; Johnson & Liber 2008). An integral part of such a PLE are the people that the learner interacts with, and derives knowledge from within his/her personal learning network (PLN). A main

assumption within the connectivist learning theory is that people not only 'consume' knowledge, but also share their knowledge as much as possible.

1.5 The issue: how to design a collaborative professional learning network that combines the best of both worlds?

The issue that we elaborate on in this paper is the following: Given a geographically and organisationally distributed group of knowledge workers within one knowledge domain, how does one proceed when commissioned to design and develop a suitable professional learning environment, especially when such a learning environment has to be sustainable and extendable, yet dependable and manageable, and open and private at the same time? How do we combine (a) support for closed communities with a high need for trust and personal security with (b) support for open and public sharing and connections to existing networks and online social network sites?

2. Supporting the specific learning needs of knowledge professionals

Today's knowledge revolution causes structural shifts for all learners. The effects of 24/7 connectivity and the increasing power and variety of Web 2.0 tools are astounding: they are fostering new forms of interactivity, information access, awareness of active peers, knowledge representation and processing. New opportunities for learning present themselves, but these opportunities require new strategies to ensure effective and productive learning. Moreover, the way in which these changing conditions affect learning needs differ quite substantially for various groups of learners.

Our concern here is to find optimal support for the continuous professional learning of knowledge workers taking into account their learning objectives and context, their work rhythm and existing learning patterns. It is about defining learning methods that match the professionals' specific learning situation: it is aimed at collective performance coping with the aspects of continuous change - changing contexts of work, changing ambitions and changing technological possibilities.

In this section we try to determine which aspects of the professional learning situation are so special that they warrant specific support strategies and tools. The characteristics of the professional learning situation will provide us with arguments not only for why the autonomous use of a PLE or private combinations of sophisticated 2.0 tools in their current forms is deemed insufficient, but also for why fully fledged, functionality rich managed learning environments or MLEs seem to fall short in accommodating precisely these professionals' learning needs.

2.1 Characteristics of professional work based learning

Due to the growing complexity of work, specialists have to collaborate and combine their knowledge to come up with new solutions for customer demands or societal issues. Thus professional learning occurs primarily on the job in connection with fellow professionals whether at the same office or distributed across locations and organisations.

As Billett, Boud & Middleton and others (Billett 2001; Boud & Middleton 2003; Bitter-Rijpkema, Sloep & Janssen 2006; Koper 2009; Sloep 2009) have observed, learning is an integral part of a job. Professional learning is strongly focused on the envisaged performance goals of a professional, and it is not something separate or special. Professional learning aims at specific outcomes, and for professionals these outcomes often require inventive problem solving rather than the application of known procedures. Moreover, professional learning often takes place under high time pressure, which has given rise to the term 'just-in-time learning'. Contrary to traditional formats of vocational or professional training, professional learning can seldom be specified beforehand. Knowledge gaps and learning needs are often identified 'on the fly' at some stage in the ongoing work process.

As a consequence, determining appropriate strategies for professional learning at work becomes a matter of finding learning methods that fit the specific performance objectives and learning context (Bitter-Rijpkema, Sloep & Janssen 2006; Jacobs 2009). These strategies include (a) finding the right people, (b) generating

necessary knowledge, (c) acquiring the necessary information or capabilities, (d) assessing their quality and appropriateness for the task at hand and (e) applying or transforming knowledge to the task at hand (Berlanga et al 2009; Billett 2001).

The fact that learning and performance occur in parallel means that professionals are looking for learning options that can be integrated with their work. (Billett 2001; Eraut 2007; Van der Klink & Streumer 2006). As a result, professionals continuously want to assess whether what they learn is transferable to their work. Moreover, this process in incremental, because once a project or issue has been solved, new ambitions and issues arise and learning needs change.

By way of summary, we can list the following relevant characteristics of professional learning. Firstly, professional learning needs tend to emerge very much in an ad hoc fashion during work activities. Secondly, professional learning is an ongoing process, an integral part of work performance. Thirdly, learning strategies and outcomes need to be relevant to work performance. Finally, at the end of a specific project (i.e learning journey) former learning targets become obsolete and attention shifts towards new learning objectives. Thus learning takes place in an iterative and incremental process, with ad hoc start and end points, depending on the orientation and dynamics of the ongoing project and actual "flow" of work. As Siemens (2005) puts it: "[...] decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognise when new information alters the landscape based on decisions made yesterday is also critical."

2.2 Exploring 2.0 PLE self-serviced learning for professional learning at work

In paragraph 1.4above we mentioned how the Internet-savvy knowledge workers have found ways of combining an array of powerful Web 2.0 tools and of adapting and combining them for individual use. Thus, professionals can develop their own personal learning environment or PLE, tailored to their individual learning style, work rhythm and environment. Each individual is able to compose, via mash-up tools like Netvibes[1], his or her personal environment, neatly fitting the person's preferred style of on-line interactivity. Through an on-line home base such as Netvibes one can connect to communities, discussion forums, social networking sites, repositories, newsfeeds, etc. in order to share interests, discuss and exchange knowledge, etc. Learning through a PLE is most often restricted to informal learning, from the discussions people share in communities, from the result of their searches and queries, from the feedback on their questions and vicariously via web or twitter contacts.

In essence, personal learning environments are organised around the individual person, his/her individual focus or broad orientation, and the person's fluid, ad hoc and more structural needs and questions. The issue in our discussion is whether these PLEs – with their strong focus on the individual – can adequately respond to the particular learning needs of professional teams or communities that work together on solving larger-scale problems, especially when these problems are related to confidential issues or matters of trust.

Quintessentially, the quality of a PLE is related to the quality and relevance of the nodes in one's personal learning network (PLN) and the strength of the connections within the network. Say, for instance, that a knowledge worker is using Web 2.0 tools to search for information and ideas in a domain that is only distantly related to his/her own. If that worker is a member of a fairly heterogeneous network then the chances are that (s)he may find the persons or resources with relevant knowledge or expertise. If that worker is a member of a homogeneous network limited to his/her own professional domain, it might take quite some time and/or effort to come to the conclusion that the necessary expertise is not to be found in his/her personal network or that the available information does not fit the problem at hand.

Use of a PLE for professional learning assumes that individuals have a good understanding of their own knowledge-ability, and that they can effectively apply the relevant learning strategies. Available Web 2.0 and semantic web technologies are powerful tools for learning, but users require new competencies to appropriate the learning capabilities of the tools and integrate the tools in their learning strategies (Minna et al. 2009). Moreover, in a team situation, the success of the learning process depends on how these personal learning strategies come together in the team process and contribute to the collective performance.

[1] *http://www.netvibes.com/*

The latter is especially important since professional work is essentially becoming teamwork in which individual specialists need to integrate their expertise to come up with effective and efficient solutions. The strength of a PLE lies in its optimal fit for the individual owner. Its prime objective is not to synchronise with others or to collaborate with others to find common ground. Personalisation and the flexible integration of functions focus on the individual user and not on the individual as a team member. Team awareness and collaboration are not at the heart of a PLE.

Moreover, comments from colleagues, clients and workshop participants show that PLEs are often perceived as unsafe collaboration environments, due to their heavy reliance on cloud-based applications and platforms. In previous professional learning projects at our institution we have found that people often formulate the need for a safe environment, where they can freely express immature ideas or remarks of a sensitive nature in closed communities, to which their colleagues or bosses do not have access. Trust is a vital ingredient in (virtual) collaborative communities, and therefore issues of access control, privacy, trust, safety and security are deemed critical for the eventual success of a collaborative professional learning environment (Rusman et al 2009).

For all the reasons mentioned above, we have to conclude that using PLEs in professional learning of knowledge workers is suboptimal for providing learning support on the key dimensions relevant for these professionals. In the next paragraph we will evaluate whether managed learning environments are a better match for the learning support needs of the professional knowledge workers.

2.3 Possibilities of MLEs for professional learning at work

Through the years, a number of managed learning environments (MLEs) have been developed for higher (university) education (Becta, 2003; Wasson 2007; Weller, 2007) and for well defined professional computer based training purposes (Wilson 2005). In the design and development of these MLEs, learning theories have been taken into account (Dillenbourg & Tchounikine 2007; Mina et al 2009; Muukkonen et al. 2005), and learning and content management standards and platforms have been defined (Koper 2009) and implemented. MLEs provide learning platforms that combine multiple functionalities in an integrated way. They are often characterised by rigid access rules, are structured according to classes or topics, and leave little control to the user. They are usually managed and controlled by an (educational) institution, and have an internal scope, i.e. they seldom refer to 'the world outside the institution'.

Evaluations of the experiences with these MLEs have been mostly limited to well defined educational settings, where the learning curriculum is explicit and learning objectives are clear and predefined. MLEs function primarily in education with cohort based groups of learners, working in rather homogeneous groups, studying the same subject, with similar prior knowledge etc. The learning path is well defined and optimised by the tutor, including the type of outcomes predicted. In short, these MLEs manage learning support very well for known groups, learning conditions and guide the learners via predefined learning paths. Exactly the qualities that make MLEs useful for use in formal education restrict their effective use for professional learning of knowledge workers.

MLEs have also been used in professional learning situations, but these situations were also characterised by a rather formal setup, with pre-defined scripts to optimise inquiry, information finding, collaborative learning, etc. (Harasim 1995; Bitter-Rijpkema, Sloep & Janssen 2006). However, as argued above, the professional learning context of knowledge workers can not be adequately supported by pre-defined scripts, as that context is often characterised by unpredictability and change.

So the learning support options offered MLEs are only suited for those activities within professional learning that can either be pre-structured, consist of a limited number of well-defined alternatives, or need well-structured communication, discussion and sharing spaces. MLEs are not suited for unpredictable learning situations in ongoing work, for just-in-time learning, or for work that involves a great deal of external knowledge or people.

In the next section we will suggest the concept of hybrid professional learning as a potential solution to the professional learning requirements of knowledge workers.

3. Theoretical heuristics guiding the design of hybrid learning networks for professional learning

In recent months, the authors have been involved in design and development of projects commissioned by professional organisations in the public domain, such as the public library and social service organisations. These organisations have observed that their professionals need to be able to collaboratively learn on the job. Experiences with conventional seminar or web-based training have not led to sufficient knowledge transfer nor to the necessary knowledge creation and exchange in cross-border professional teams working in the same field. Consequently, their question was how to address the challenge of effectively supporting non-formal learning of these knowledge workers in parallel with and preferably integrated into their daily (problem solving) activities together with peers from other organisations, in short learning situations which Webster-Wright (2009) labelled 'authentic continuous professional learning'. In essence, our task is to develop modern communities of practice, knowledge networks or digital habitats (Wenger, White & Smith, 2009), making optimal use of current learning technologies and learning support strategies. We are currently in the development and testing stages of these projects.

The basis of the solution that we are working on builds on the work of Koper (2009), Sloep (2009) and colleagues. The underlying idea of their work on learning networks and learning communities is that individual learning takes place in a social context. Learning support for professionals however has to allow maximal flexibility to match the dynamics of organisational teamwork concurrently coping with the individual's autonomy on the one hand and structured support for collaboration and team learning on the other hand (Webster-Wright 2009).

This balance between structure and freedom or accountability and agency (Borko et al. 2007) distinguishes hybrid professional learning networks (HPLN) from PLEs and MLEs. The learning design in our projects focuses on triggering the emergence of learning communities capable of supporting the knowledge worker's (learning) objectives for his/her task at hand.

Various researchers have investigated which circumstances are helpful and which pedagogical interventions trigger social interactions and learning amongst a learning community's participants (Sloep 2009; Berlanga et al. 2009; Mandell et al 2009) or make better use of the collective knowledge that emerges in these working environments. Recent research (Berlanga et al. 2009) suggests critical issues to take into account and pedagogical strategies to trigger learning in these communities. (Sie, Bitter-Rijpkema & Sloep, .2009) These suggestions have been tested in a prototypical setup with users and now serve as the basis of the design of real life learning networks for knowledge professionals in public services.

Some of these suggestions are: firstly, to offer community members self management, i.e. functionalities to create their own profile, contacts, etc. by which they can decide on how to profile and position themselves in this work community; secondly, to offer affordances that permit users self organisation as community members and as a team, so that the members themselves have options to configure and organise interaction, to comment, recommend, search and rate and combine this with possibilities of autonomous knowledge categorisation, enabling professionals to decide on methods to classify and evaluate contributions. Last but not least, it is very important - especially for professional learning communities - that community members themselves can regulate access to their professional learning, and thus have control over their decisions regarding private, limited or public activities or knowledge (Berlanga et al. 2009; Wigman, Hermans & Verjans 2009). The learning environments in which these communities emerge need to support a high degree of flexibility as to the nature of each learning community.

Finally, the current design builds on the benefits of PLEs in the sense that users can choose to publish automatically their knowledge to their personal learning environments, can make use of online services such as social bookmarking, and/or can integrate external knowledge feeds in their learning community (Hermans & Verjans 2009).

The resulting hybrid personal learning network infrastructure will provide a portal-like online environment, hosted and managed by their own organisation or by a trusted partner, an environment in which the user

has maximal control. The more MLE-oriented network members can setup communities and groups and decide who gets access to these groups, both internal and external. They can then use these closed or semi-open communities to develop and share knowledge, which they can later open up to the public or a wider community if they so choose. When information becomes publicly available it can then be syndicated on external (personal) learning networks through RSS-feeds. PLE-oriented members – on the other hand - can continue using their PLE, and choose to provide the organisational MLE with - filtered or unfiltered - RSS-feeds from their personal environments. An early prototype of such a HPLN was used during the online course on Connectivism and Connected Knowledge '09 (Siemens 2009). During this course the more MLE-oriented participants could enrol and participate in a closed learning environment (Moodle), web conferences (Elluminate) and receive a daily mail update, whereas the PLE-oriented participant could go on using his PLE. In order to get their contributions from their PLE into the course discussion, these participants could tag them with an agreed-upon tag, and inform the organisers about his RSS-feeds, so that their input could be aggregated and fed into the closed environment.

4. Conclusions and future research

In this exposé we observed that today's professional learning requirements of knowledge workers are not completely met by existing learning technologies, neither by institutional MLEs nor by Web 2.0-based PLEs. We concluded that we need to combine the strengths of both types of learning support. We need some of the safety, access control and predictable structure of an MLE combined with the personalisation, openness and flexibility offered by PLEs in order fully to accommodate the learning needs and constraints of knowledge workers.

We introduced the concept of hybrid professional learning networks (HPLN) as an option to address the professional learning requirements of knowledge workers. Firstly, HPLNs support the building of an online learning network as a social network. Secondly, they can be designed to optimise learning to support the continuously changing learning needs in the real life practices of (working) professionals, since they do not link to predefined structures, which would limit their flexibility. HPLNs are environments that afford self-expression and self-organisation of the participants according to their wishes. And they need to present supportive recommendations and collaborative guidance suggesting appropriate learning strategies based on sound scientific heuristics.

The next steps are further to implement and evaluate the prototypical HPLN for our public service, building on the positive feedback on our first prototype. Multiple case evaluation of such hybrid networks in different contexts will show which learning effects are generated and how can these be interpreted. These evaluations can then be fed back into the theory building process.

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Index of Authors