Rich and personal revisited: translating ambitions for an institutional personal learning environment into a reality

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Abstract

Is it possible to create an institutional personal learning environment? This question has triggered considerable debate amongst those concerned with implementing learning and teaching technologies within higher education,

Rapid technological change is necessarily accompanied by matched evolution of individual practice amongst users. At universities, students arrive with a mix of sophisticated and naïve approaches to using technology in everyday life which can be shaped and harnessed to support learning.

To respond to the changing capabilities and demands of available technology, the University of Southampton designed and is implementing a rich holistic learning environment radically different from the VLEs which gained widespread usage since the late 1990s. In the initial scoping of the environment, explanations of the proposed system were qualified: "its more than a system, it's a mind-set".

The suggestion is that the power and value of the institutional personal learning environment resides in the 'technology affordances' which enable users to customise and personalise the system in a socially useful and educationally constructive manner. There are many different ways to remove the barriers to learning, some of which are not necessarily directly 'educational' or 'instructional'.

This paper considers the foundations and emergence of personal learning environments and the interplay of ambitions and requirements needed to support learning in a university context. It goes on to make a case for the creation of a seemingly paradoxical embodiment – an "Institutional Personal Learning Environment (iPLE). It considers emerging understandings of the role of 'digital literacies' and their associated challenges to universities - the role and challenges of 'scholarly literacies in a digital age'.

Presenting a case study of implementing the Southampton Learning Environment, this paper analyses the underlying rationale of the emerging system. It evaluates the architecture of the system to explain how it provides an institutional personal learning environment. It presents and reviews the first cycle implementation (due to go live in August 2011) from a pedagogic perspective assessing the technology affordances of the system. Finally it re-evaluates the evidence to consider whether it has indeed been possible to create an institutional learning environment that is also a personal learning environment.

1. Introduction

Personal learning environments as we know them today are another step in the steady evolution of the use of technology for education which has its distant roots in the transition from the design and use of the very first writing devices, through to the creation of the library at Alexandria and on to the Socratic dialogues of ancient Greece. More conventionally and recently we have accounted the history of educational technologies as a progress beginning with early computer based training

and military simulations (Saettler 1967). Subsequent developments have been characterised as of eLearning and technology enhanced learning (TEL) which have then been integrated with organising and administrative functions know as managed and then virtual learning environments (VLEs). The narrative of this transition strongly reflects early technological realities, while change in the dominant models and approaches can be interpreted as reflecting the advent of personal computers and the world wide web. Similarly, the realisation of the read-write web through the implementation of web2.0 (O'Reilly 2007) and the growth of the social web (Shirky 2003) is often identified as the roots of personal learning environments (PLEs) which are in themselves seen as a radical departure from the Fordian and centralised directed nature of education which is supported and to some extent reinforced by managed and virtual learning environments.

At the same time that the technological fabric of society has been moving to enable greater levels of access and participation via personal and mobile computers, so too the educational discourse has shifted its emphasis away from models which give primacy to knowledge, instruction and the role of the teacher. Clearly identifiable theories, models and frameworks of eLearning have emerged (Mayes and de Freitas 2006) which seek to embody particular educational and pedagogic paradigms.

The means of attaining educational objectives is no longer explained in terms of empty vessels waiting to receive knowledge, rather, the role of education is to help the learner access, understand and master the valuable processes which we believe underpin learning.

Irrespective of whether such learning is set with the confines of a managed or virtual learning environments, or is imagined within the framework of individual personal learning environments, the three early steps of writing/recording, sharing and scholarly discourse remain core educational components.

The emergence and popularity of virtual and managed learning environments and the apparently challenging emergence and popularity of personal learning environments can to some extent be reconciled by recourse to the well established arguments of the social shaping of technology, see for example William and Edge's review of research in this area (Williams and Edge 1996) and Mackenzie and Wajcman's (MacKenzie and Wajcman 1999) subsequent collection of essays. Following these arguments, the technologies which we use to enable and support learning are merely functions of the social processes which surround the devices and systems which operate in any particular social, cultural and historical context. From this perspective it begins to be possible to imagine that a personal learning environment might have an institutional facet. Learners will inevitably craft their own personal learning environments and the social context in which they operate; the community of scholars which nurtures them; and the organisation which ultimately validates and accredits their learning, will also have a role.

Our understanding of the socio-technical interplay, and a desire to create an effective, resilient and relevant environment for our learners has in turn shaped our approach to the design process of our institutional personal learning environment (iPLE). Furthermore, it is the recognition, value and inevitability of this social shaping which we believe makes the case for iPLEs particularly strong, and which would predict that the iPLE will become a reality across a wide range of Higher Education Institutions over the coming years.

Our account of the development of the Southampton Learning Environment, and instantiation of an iPLE analyses the specification and implementation from an educational, organisational, technical and socio-cultural perspective. A more technical perspective on this work can be obtained from the paper 'Towards an Institutional PLE' (Millard, Davis et al. 2011).

This paper establishes the background which furnished the ambitions to create a Southampton Learning Environment, it take and organisational overview which examines each of the components of the environment and analyses the developments which have taken place thus far.

2. Background

There is clear evidence of institutions are already attempting to build environments which will provide their students with some of the benefits of Personal Learning Environments e.g. see for example (Santos and Pedro 2009; Casquero, Portillo et al. 2010; White, Davis et al. 2010). Typically such implementations combine educational, technological, organisational and social motivations.

Educationally PLEs are recognised as reflecting learners' autonomy allowing them to choose tools and services which suit their individual educational objectives and meeting the constraints of their technological and cultural context. The idea of the university as "A community of scholars and students engaged in a common task" is attributed to the 20th century philosopher Karl Jaspers 1959 publication 'The Idea of a University'. Jaspers also believed that the institution should provide "The time and place for learning" (Fincher 2000). Academics seek to enable an education which is transformative increasingly valuing situated learning (Lave and Wenger 1991) and the growth of communities of practice (Wenger 1998).

The technological and organisational arguments necessarily overlap. Some simple points are sometimes overlooked in the arguments. Although learners may provide, use and choose their own technology, the university inevitably provides some infrastructure, physical and virtual. Furthermore since the university administers the education, and most importantly to both learners and the organisation accredits any educational achievement it is in everyone's interest that the systems work well and smoothly and are able to interoperate. Furthermore the university must provide these services in a way which it can afford.

From a technological viewpoint one can argue that institutionally provided technology can never be personal. The institution has already decided upon the technical framework and thus may have removed or severely constrained the learner's choice – for example in platform, software and mode of interaction.

The underlying assumption of the work described in this paper is that the university's virtual infrastructure must offer variety and support opportunity in the same manner as the traditional physical infrastructure. The loose association and co-location of resources, available to all but used selectively by each individual, should exist in the virtual as well as the physical.

We are not attempting to provide an environment that will last for the next ten years; rather we are building a technological framework (learning environment) which can evolve with emerging technologies through its lifetime. This framework acquired in a manner akin to Mayes 'vicarious learning', is designed to guide learners towards acquiring the set of personal digital literacies, demonstrated by 'super-users'(Fournier and Kop 2010), that are most relevant to their personal, educational and career choices.

Learners do not spend a lifetime using our environment, but we aspire to offer them educational opportunities which result in a transformative educational experience and which will sustain them through their future learning in whatever form it takes emerging as confident and competent participants in a digital future.

The initial scoping stages of the environment described the proposed system accompanied by the qualifier "its more than a system, it's a mind-set". The suggestion is that the power and value of the iPLE resides in the affordances of the technology to enable users to customise and personalise technologies in an educationally constructive way (White and Davis 2011) effectively enabling a 'digital cognitive apprenticeship'. There are many different ways in which one can remove the barriers to learning, some of which are not necessarily directly 'educational' or 'instructional'.

3. Designing the iPLE

Describing studies of Social Shaping of Technology as a challenge to the model of 'technological determinism, Williams and Edge argue:

> "SST studies show that technology does not develop according to an inner technical logic but is instead a social product, patterned by the conditions of its creation and use".

Weller talks about the challenges thrown up by a desire to achieve openness, robustness and decentralisation – and an associated conflict between individual and organisational culture (Weller 2007). It is such tension and conflict which we are seeking to resolve. Taking the web 2.0 model of a perpetual beta into the inherently risk averse and centralised practice of university administration and technology infrastructure is a necessary challenge if we are to address the needs of our students and keep our overall operating costs at an effective minimum.

Southampton is a large research-intensive university and member of the Russell group of leading universities. It also has a very large taught student population; more than 23,000 full time equivalent undergraduate and masters level places in 2009/10 with a large proportion (around 20%) of students coming from outside of the UK[1]. It teaches across a broad range of academic disciplines from Physics to Fine Art and Philosophy to Nursing and the majority of its researchers also fulfil active teaching roles.

Its a long established devolved management system has in recent years has been reorganised, but individual areas of research and teaching programmes still retain strong individual identities. In working to design and create the Southampton Learning Environment we have taken conscious steps to accommodate social factors.

Early steps toward the vision of a Southampton Learning Environment can be seen in the Scholar Project of the early 1990s which sought to create 'a campus-wide structure for multimedia learning' (White 1993). Practices changed as the use of the web was introduced and became widespread via different discipline-based developments run and administered across a range of internet connected local networks. An institutional VLE and computer assisted software was introduced. Alongside this, like many other universities, Southampton introduced a content management system which it used to form a portal providing intranet information to

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[1] Source the UK Higher Education Statistical Agency http://hesa.ac.uk

students, academics and administrative and support staff. Surveys of staff and students were conducted in order to deepen our understanding of perceptions of technology in learning and the students' experience (White 2006). A review of online educational practices across the university using the eLearning Maturity Model (eMM) Benchmarking protocols (Marshall and Mitchell 2006) was conducted In 2007-8 (White and Davis 2008). This information provided detailed additions to routine data collected through the university's quality assurance processes which monitor and evaluate the institution's educational processes, further motivations and leadership for change then came in a major curriculum innovation programme launched in 2009. Details of these activities are discussed elsewhere (White and Davis 2011).

Other activities have been influential in the approaches adopted for the planned innovation. The university researches, developed and uses repository software for research and teaching, gaining valuable experiences and insights from these activities (Hitchcock, Brody et al. 2007; Millard, Howard et al. 2009; Davis, Carr et al. 2010). Academics in Electronics and Computer Science (ECS) have been working with systems using linked and open data for some years and most recently the university has become one of the vanguard of institutions committed to implementing open data policies (Lewis 2011) across the whole organisation[2]. ECS has developed its own data-driven set of websites, including a data-driven educational site which also interacts with our Educational repository EdShare[3] and a range of social tools and external services such as delicious. Lastly, a major curriculum innovation in health sciences (O'Halloran, Hean et al. 2006) preceded an institution-wide curriculum innovation programme (University of Southampton 2011) which underlined the commitment from the university to drive the change.

It is in this context that discussions to design the new environment began with a cross-section of colleagues encompassing academics and the professional services plus some student representatives. Working to a system brief that stipulated supporting 'Living and Learning' numerous models of the final system were discussed; we based our planning framework on the concept of a 'rich learning environment'.

In the process of transforming our aspirations into reality it was necessary to embody requirements and ambitions which matched our educational, organisational and technological requirements. At the same time it was essential that any system, fit for the twenty-first century was able to meet and exceed students expectations: hence our refrain 'it's *more than a system, it's a mind-set*'.

3.1 Vision – crafting a rich learning environment

Rich learning environments are dynamic spaces which integrate personalised information and technologies across a core of resources to support the learner in addressing their educational needs. They have their roots in the constructivist ideas of Grabinger and Dunlap (Grabinger and Dunlap 1995). Rich learning spaces exploit the technology affordances of their component parts, but provide added value by simplifying and customising the interface to a set of complex and diverse resources based on a learners' context and education needs. These needs might be visualised

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[2] http://data.soton.ac.uk

[3] http://www.edshare.soton.ac.uk/

into four broad areas, which sit in the context of an online social space, as shown in figure 1
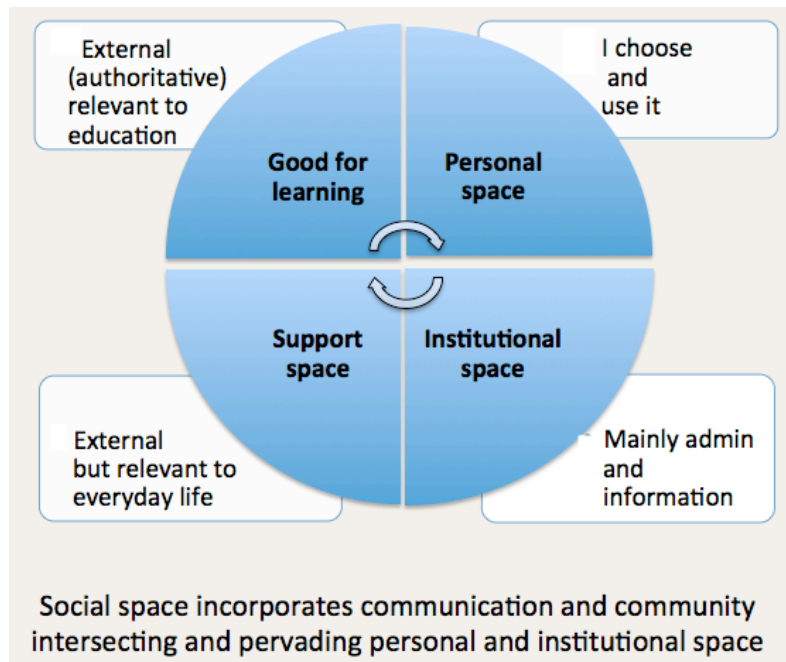

Figure 1 The rich learning environments incorporates the pervasive social space

The seeding of ideas for the rich learning environment has been explained above. In particular prior experience in ECS, feedback from student surveys and direct input from student union reps were influential in shaping the Southampton mind-set. Analogies between the physical places and practices and their virtual equivalents were constantly referenced and borne in mind. Functions and relationships of each part of the environment inter-relate. See figure 2 for the conceptual structure explained below.

3.1.1   Institutional Space.
The institution in which the learning is studying, or at which the learner proposes to study, will have 'spaces' which have a role in informal or formal learning and learning support. It is possible that the set of spaces will change during the learner's route through education with the institution. Sites/sources will be of varying importance at different times.

At Southampton students may routinely access a number of discrete spaces - e.g. University official web site; the school, departmental or faculty public web site, and parts of these previous sites located behind a firewall only accessible to individuals who have an official role within the University. Portals, learning environments, assessment spaces and similar specialised sites which are used for secure information may be further protected requiring password access. University libraries subscribe to journals and eBooks, and such access will have some kind of controlled gateway.
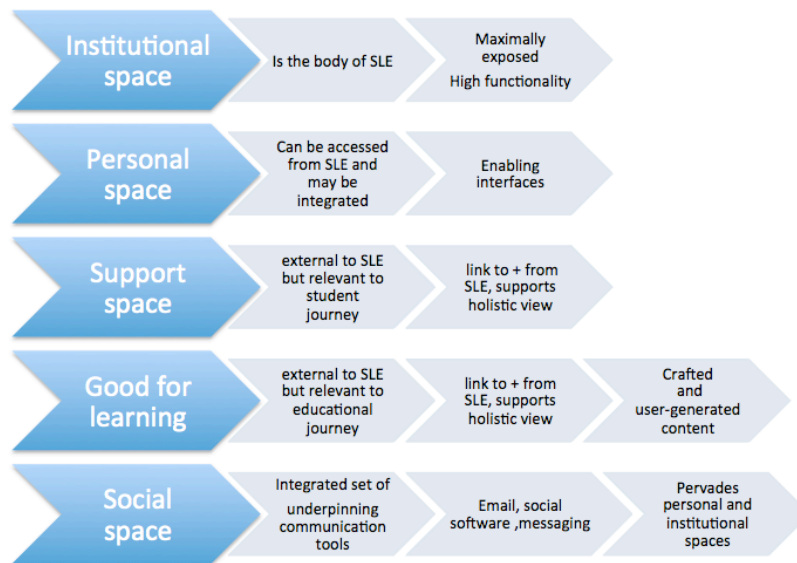
Institutional space — Is the body of SLE — Maximally exposed, High functionality

Personal space — Can be accessed from SLE and may be integrated — Enabling interfaces

Support space — external to SLE but relevant to student journey — link to + from SLE, supports holistic view

Good for learning — external to SLE but relevant to educational journey — link to + from SLE, supports holistic view — Crafted and user-generated content

Social space — Integrated set of underpinning communication tools — Email, social software, messaging — Pervades personal and institutional spaces

Figure 2 The key components of each part of the environment indicating function

3.1.2 Personal Space:

A learner will already make use of their own preferred tools and applications which may be used either in addressing the demands of formal learning (e.g. using Google docs to create a word-processed document) or informal learning (using delicious to store and find information and resources on study-related topics). Each learner will have (most likely) their own machine(s) (laptop, desktop, mobile) use associated operating systems operating system and will have selected and be familiar with a set of tools. Some parts of this (e.g. Skype, text messaging) may not be clearly linked or associated with learning tasks, but may still be of great importance to the student.

3.1.3 Support Space

Depending on the context of the student, there will be external spaces which might be useful or relevant for formal and informal learning. For example in Southampton the students' union web site SUSU.org provides information and support, for all students. For international students their home country embassy site, or some official UK government sites may be of importance. Information which is published by the local council, or the student loans company many also belong in support space. The distinguishing feature of these support spaces is that although they are known to be directly relevant to some students, they are not published by the university in any official manner.

3.1.4 'Good for learning'

Students may benefit from information and resources which are located outside their current personal space, and outside the institutional space. This is typically generic information rather than anything which is specifically relevant to a student's programme of study or individual circumstances. For example the National Union of Students offers support and advice related to study and examinations. There are other sources of information such as advice on advice on approaches to learning, second language study, work life balance, preparing for work. Such information may be produced by known organisations of good authority (for example professional bodies) or may be published by knowledgeable enthusiasts identified by page rank.

3.1.5 Social Space

Underpinning and pervading the environment there is an integrating layer provided by social space. This incorporates email, messaging, and social software. It acts as the glue for the environment. The challenge here is to understand that we cannot legislate what systems our users choose to adopt, but we must provide tools within an open and configurable system to that users do feel at home in their environment.

3.2 Responsive and agile for radical change

The full story of the processes we have used to build our first prototype can be read in Millard et al, 2011, but importantly we have radically changed the approach to software development.

We have adopted an agile and incremental approach to the development. Agile methods are very much core to contemporary software development practices. In the past the university has taken a fairly standard approach to software development where users express their requirements, a design is agreed, and then the system is implemented: when the implementation is complete a user acceptance trial is undertaken to ensure that the delivered system conforms to the user requirements. Such approaches are losing favour with more progressive developers dealing with large complex and fast changing organisations.

In designing the SLE we envisaged a single front end to the University of Southampton environment to access everything the university would provide for student needs in living and learning; we intend to support them in through the journey – from pre-enrolment to alumni. We also wanted to provide the infrastructure that academics, support staff and administrators would need to support teaching, research and administration. It was crucial that the system had appropriate and secure interfaces to all administrative systems.

The agile development is needed for an agile university. We understand that, at this moment, most teachers and learners, if asked to specify a system, would not design the system that we intend to deliver (it is part of our digital literacies agenda to change their understanding), and we understand that, by time the first few years of incrementally delivering what we have specified have passed, our understanding and requirements will change. We also realize that we have many legacy systems (such as Blackboard) and staff will not thank us for taking away tools, in which they have invested so much, until they are familiar with and confident in the alternatives.

Important features of out initial specification are:

- *Single point of access:*
  access to all Southampton provided tools and resources with a single login; high quality search within all of the university space.

- *User Profiles:*
  Every user has a 'profile' within the university. Part of this profile is generated automatically from university information about the student or staff member. The user can complement this with other information they wish to share in a Facebook-like style. Users can choose to make profiles visible outside the university. Profiles are essential for social networking and collaboration.

- *Landing Page:*
  Each user "lands" when they logon to the system, which provides essential information and allows the user to organise other information as required.

- *Personalisation and Personalisability*:
  Page layouts, announcements and feeds are personalised to the user who can take responsibility for choosing their own layout and tools from an "AppStore" of widgets (similar to iGoogle).

- *Storage*:
  Every user controls their storage space which they can use privately, share with selected users, make public (similar to DropBox) where they can develop their own web sites for internal or public use.

- *Communication*:
  An agreed set of tools provided by the university for email, chat, video-conferencing, blogging, wikis, presence etc. – conforming where possible and appropriate to establish protocols. Although users may have their own preferences for such tools the university cannot support them all, and if there is no agreed protocol then islands of communication develop.

- *Collaboration*:
  Tools to support collaborative authoring and project management. Many of the collaborative and communication tools are provided in the cloud.

- *Open Data Access*:
  Southampton has adopted an open data policy (Lewis 2011). Important and non-confidential university data is openly published e.g. Classroom location and facilities, timetable, room bookings, café locations and opening times, bus arrivals and departures. Writers of mobile applications and widgets are free to use it.
  We are also tackling the issue of making confidential information equally accessible to authorised users (marks, fees-status, personal timetable), again in such a way that mobile applications and widgets may be developed.

- *Mobile tools:*
  We have provided an initial set of mobile tools (using mobile web and some iPhone specific applications) and are encouraging further user driven development.

Following the agile model, we are developing these aspirations in close collaboration with all parts of the university which led to praise for the achievements of the sprint teams and requests for an early release.

First hand experience of co-design and co-evolution has made an enormous contribution to our change agenda. As previously stated, and our working methods also reflect an awareness of learning which is explained by Stewart which emerged from a European project on Social Learning in Multimedia (Stewart and Williams 2005)

> *"offerings [as] inevitably unfinished in relation to complex heterogeneous and evolving user requirements. …. To be used and useful, ICT artefacts must be 'domesticated' and become embedded in broader systems of culture and information practices. In this process, artefacts are often reinvented and further elaborated ('innofusion')"*

4. Discussion, Conclusions and Future Work
Awareness and discussion of the approaches which we have adopted are not new. In building the Southampton Learning Environment we are confirming Scott Wilson's observation that rather than threatening institutions decentralised personal

technologies offer an escape from a pattern of escalating technology provision that is unsustainable. However our realisation seeks to find a place for the personal within the institutional, in the same way that learners already preserve their own physical social identity when they join and become part of a university community.

From a pedagogic perspective one might argue that reliance and use of any institutional initiative and infrastructure would necessarily sabotage and undermine personal autonomy, however the university is one society in which our learners have chosen to join. We believe we have found a way to ensure users do not rely on an institutional infrastructure which detracts from the inherent levers for independent learning. Rather our environment will assist and cultivate learning by enabling learners to individually assemble and thus creating a personal learning environment for life.

The technological realisation which we are instantiating bears the hallmarks of designers and users who are soaked in the practices of social software and open data. The adoption of agile methods builds trust and respect in all parties essential is we are to successfully engage in the processes of co-evolution and co-creation. Just as we want our learners to build their capacities, so our system has to be able to change and evolve. This requires a radical change whilst respecting traditional educational values. The primacy of the academic and the role of education as an apprenticeship process cannot be lost. Apprentices go on to become masters, our students today will become the thought leaders and decision makers of tomorrow. It is our responsibility to ensure that an institutional personal learning environment is not seen as an oxymoron akin to 'military intelligence'. Our leaning environment needs to be crafted in such a way that it becomes one further aspect of student life, like the students' union and the library, there to be valued for what it does and provides, often in ways rather different from those which were first envisaged as it takes our students through their digital cognitive apprenticeship.

5. References

Casquero, O., J. Portillo, R. Ovelar, M. Benito and J. Romo (2010). "iPLE Network: An Integrated Elearning 2.0 Architecture from a University's Perspective." Interactive Learning Environments, **18**(3): 293 – 308.

Davis, H., L. Carr, J. Hey, Y. Howard, D. Millard, D. Morris and S. White (2010). "Bootstrapping a Culture of Sharing to Facilitate Open Educational Resources." IEEE Transactions on Learning Technologies **3**(2): 96-109.

Fincher, C. (2000). "Recalling Karl Jaspers' Classic: The Idea of the University." IHE Perspectives April 2000.

Fournier, H. and R. Kop (2010). Researching the Design and Development of a Personal Learning Environment. PLE 2010. CitiLab: Barcelona http://bit.ly/PLE10FournierKop.

Grabinger, R. S. and J. C. Dunlap (1995). "Rich Environments for Active Learning: A Definition." ALT-J **3**(2): 5-34.

Hitchcock, S., T. Brody, J. Hey and L. Carr (2007). "Digital Preservation Service Provider Models for Institutional Repositories: Towards Distributed Services." DLib Magazine **13**(5/6).

Lave, J. and E. Wenger (1991). Situated Learning: Legitimate Peripheral Participation, Cambridge University Press.

Lewis, J. (2011) "University Pioneers Open Data Revolution." University of Southampton, Electronics and Computer Science, Press Release http://www.ecs.soton.ac.uk/about/news/3663.

MacKenzie, D. and J. Wajcman, Eds. (1999). The Social Shaping of Technology. Buckingham, UK, Open University Press.

Marshall, S. and G. Mitchell (2006). Assessing Sector E-Learning Capability with an E-Learning Maturity Model. ALT-C Association for Learning

Technologies Conference, Edinburgh, UK.

Mayes, T. and S. de Freitas (2006). Review of E-Learning Theories, Frameworks and Models JISC e-Learning Models Desk Study. Bristol, JISC: 43.

Millard, D., H. Davis, Y. Howard, P. McSweeney, D. Morris and H. Solheim (2011). Towards an Institutional PLE. The PLE Conference 2011. Southampton, UK.

Millard, D., Y. Howard, P. McSweeney, K. Borthwick, M. Arrebola and J. Watson (2009). The Language Box: Re-Imagining Teaching and Learning Repositories. International Conference on Advanced Learning Technologies. Riga, Latvia.

O'Halloran, C., S. Hean, D. Humphris and J. Macleod-Clark (2006). "Developing Common Learning: The New Generation Project Undergraduate Curriculum Model." Journal of Interprofessional Care 20(1): 12-28.

O'Reilly, T. (2007). "What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software " Communications & Strategies 1(First Quarter 2007): http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1008839.

Saettler, P. L. (1967). A History of Instructional Technology. New York, McGraw-Hill.

Santos, C. and L. Pedro (2009). Sapo Campus: A Social Media Platform for Higher Education. m-ICTE 2009: Research, Reflections and Innovations in Integrating ICT in Education, Lisbon, Portugal, http://www.formatex.org/micte2009/book/1104-1108.pdf.

Shirky, C. (2003) "A Group Is Its Own Worst Enemy - a Speech at Etech, April, 2003." Clay Shirky's Writings About the Internet: Economics & Culture, Media & Community, Open Source http://www.shirky.com/writings/group_enemy.html

Stewart, J. and R. Williams (2005). The Wrong Trousers? Beyond the Design Fallacy: Social Learning and the User Handbook of Critical Information Systems Research. D. Howcroft and E. M. Trauth, Edward Elgar: 195-221.

University of Southampton. (2011). "Curriculum Innovation Programme."   Retrieved May, 2011 http://www.soton.ac.uk/cip/.

Weller, M. (2007). "The Distance from Isolation: Why Communities Are the Logical Conclusion in E-Learning." Computers & Education 49(2): 148-159.

Wenger, E. (1998). Communities of Practice: Learning, Meaning and Identity, Cambridge University Press.

White, S. (1993). Scholar - a Campus Wide Structure for Multimedia Learning. AETT Annual Conference: Designing for Learning, Jordanhill Campus, University of Strathclyde, Glasgow, Kogan Page.

White, S. and H. C. Davis (2008). Emm Benchmarking at Southampton:The Carpet, Observations and Reflections. Technical Report LSL-EL-0108, ECS, University of Southampton.

White, S. and H. C. Davis (2011). "Making It Rich and Personal: Crafting an Institutional Personal Learning Environment." International Journal of Virtual and Personal Learning Environments In press http://eprints.ecs.soton.ac.uk/22030/.

White, S., H. C. Davis, P. Hancock and D. Morris (2010). Making It Rich and Personal: Meeting Institutional Challenges from Next Generation Learning

Environments. PLE 2010, Barcelona, Spain, CitiLab
http://pleconference.citilab.eu.

White, S. A. (2006). Higher Education and Learning Technologies: An Organisational Perspective. Electronics and Computer Science. Southampton, UK, University of Southampton. PhD.

Williams, R. and D. Edge (1996). "The Social Shaping of Technology." Research Policy **25**(6): 856-899.