Semantic Technologies for the Enhancement of Case Based Learning: Case for Support

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1. Introduction

This interdisciplinary research and development project will contribute both to understanding of pedagogical practices in case based learning across disciplines, and to the development of semantic web tools and learning environments. It will therefore provide a framework for developing the potential of the 'educational semantic web' and offers a timely opportunity to develop innovative educational strategies.

The project takes, as its starting points, a recognition that:

- pedagogical practice can be understood as dynamic relationships between teachers, learners, subject area knowledge and various technologies, all involved in a co-production of knowledge (Latour, 2005; Law, 2004; Patel, Solomon and Solkin, 2007);
- effective knowledge transfer involves active reconstruction and reconceptualisation on the part of learners (the 'knowledge-creation metaphor' of Hakkarainen et al, 2004);
- active engagement of 'users' necessitates a recognition that these users have multiple identities including researcher, learner, professional, worker, designer, and developer (Chappell et al., 2004);
- the use of case studies as a teaching and research method is both useful and problematic for teachers and learners (Stenhouse, 1978; Walker, 2002);
- educational technologies are a collection of digital artefacts which users configure, tailor, combine, adapt or find other usage for, but which also goes beyond those envisaged in the original design (Ciborra, 2000, 2002; Suchman, 2007);
- the 'Semantic Web' both as a general vision (Berners-Lee, 2001; Shadbolt, Berners-Lee and Hall, 2006) and as a set of tools, interfaces and standards, offers a basis for representing and reconstructing complex, heterogeneous and fragmentary data alongside structured, authoritative and trusted sources. At the same time multiple vocabularies, representations and formalisms will be required to support teaching and learning across diverse contexts and settings;
- learning and work environments, and teacher, learner, research and worker identities, technologies and knowledge are in flux (Symes and McIntyre, 2000; Chappell et al., 2004; DuGay et al., 2000; Gibbons et al., 1994; Castells, 2005; Edwards and Usher, 2007);
- social science, and computer and information science are themselves in a state of flux, with new theoretical orientations and research methodologies which borrow from different philosophical and epistemological traditions and from each other (Edwards and Miller, 2007).

2. The Pedagogical Challenge: Enhancing Case Based Learning

Case based learning is the pedagogy of choice when knowledge domains are complex, unpredictable, politically or ethically contentious, or so rapidly changing and fluid that a curriculum defined in terms of knowledge or competences alone is inadequate as the basis of developing expertise. Engagement in case based learning and the reflective processes that accompany it allows learners to achieve the higher levels of understanding and capability that characterise the 'expert' (Dreyfus and Dreyfus, 1986, Flyvbjerg, 2002), or the 'virtuoso' (Bourdieu, 1977), especially in domains where dealing with complexity is seen as indicative of this expert performance. As such, it is a desirable learning outcome for advanced

undergraduate and postgraduate courses and programmes of professional learning (Eraut, 1994; QAA, 2005).

Like other examples of 'higher order learning' it can "transcend other learning outcomes … lack[ing] a clarity of meaning that is commonly shared and agreement about how they are to be assessed" (James and Brown, 2005, 11). As such it aligns with problem-based learning (e.g. Savery, 2006), inquiry-based learning (e.g. Ragin, 1992a), simulation (e.g. Bruzzone and Masco, 1998; Hertel and Millis, 2002; Kaufman, 1998; Stover, 2005), design experimentation (Fishwick, 1995), creative exploration (e.g. Cannon and Schwiger, 2005; McLaughlan and Kirkpatrick, 2004; Schrage, 1999) and some aspects of 'authentic learning' (Roth, 1999; Miettinen, 2001).

A number of studies have noted the superficial claims made for case based learning in terms of 'active learning' and 'participative processes' (Burgoyne and Mumford, 2001), and problems with universalistic claims generalised across diverse setting (Booth *et al*, 2000). This suggests that there exists a research gap in understandings of the nature, scope and role of the case and what it is perceived as offering. There are various characterisations of 'case' and 'case study' from which follow research questions about their pedagogical role: Stake's (1995) distinctions between the intrinsic and illustrative; Ragin's (1992b) typology which distinguishes between theoretical/empirical and specific/general; and distinctions between typical, critical and paradigmatic cases (Yin, 2002; Flyvbjerg, 2002). Similarly, the role of generalisation from cases is contested and varies widely across disciplines: cases may be generalised to theory or to models (Eisenhardt, 1989, Stake, 1995), or there may be a resistance to diminish what Flyvbjerg calls 'the irreducible quality of good narrative' (2002, 84). What is not clear is how this conceptual literature maps to the pedagogical application of cases - to case based learning - in practice across disciplines and educational settings, and how best this diversity of practice can be theorised.

Case based learning is implemented as a pedagogical strategy in a range of educational settings in higher education and professional learning. The approach is well documented in medical education and in areas such as management and business education (Christensen, 1987) in which approaches such as the 'Harvard' model of close interrogation of a personal narrative form the basis of teaching and learning activities, but is widely practiced in other areas. It is against this background that the project has selected six different disciplinary settings across two universities in order to investigate the role of case based learning: these are summarised in the section "Research Settings". While case based learning is established across the settings, it is clear that there are disciplinary differences in underlying conceptions of the nature of cases, their generalisability and their status in relation to other forms of knowledge.

Teachers and learners will take part in 'case-building' activities in which semantic web tools and digital repositories are used to support engagement with rich case data, differently structured and represented and in which alternative constructions of cases are possible. This develops ideas originally developed by Stenhouse (1978) and subsequently elaborated by Walker (2002), in which the role of appropriately structured and mediated data sources provide a basis for multiple and cross-case analyses and application in a wide range of teaching, learning and engagement activities. The learning outcomes of these activities will, as James and Brown (2005) suggest, be complex and discipline-specific, but they will be theorised both in terms of individual learners' outcomes and their contribution to the shared resources of academic and professional knowledge-constructing communities (Hakkarainen et al, 2004).

3. The Technological Challenge: Realisation of the Semantic Web in Educational Settings

The Semantic Web is conceptualised as "an extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation … data on the Web [is] defined and linked in a way that it can be used for more effective discovery, automation, integration, and reuse across various applications." (Semantic Web Activity Statement, 2001). The flexibility of key Semantic Web technologies allows the integration of user-generated content with that from digital repositories, web services and 'non-semantic' data such as 'legacy' databases. They offer the user advanced search tools and a range of representations and visualisations of data. They also support 'social software' functions such as reviewing, rating and collaborative annotation. This means that these technologies can provide a framework capable of supporting the individual and collective engagement in case based learning described in the previous section.

The realisation of an 'educational semantic web' is, however, a space 'open to be filled with meaning' (Allert, 2004, 2). In a teaching and learning environment in which the potential of semantic web technologies had been fully realised, teacher and learner engagement would be fluid, flexible and generative (Koper, 2004). Until now, most Semantic Web applications have concentrated on data discovery aspects (see for, example Fensel et al., 2003 and Nemirovskij et al., 2007). In this respect, the 'Educational Semantic Web' is at a stage in its development comparable to the Internet prior to the Mosaic Web Browser in 1993, when the Internet too was conceptualised primarily as accessing or disseminating information, rather than as a learning environment or means of collaboratively constructing knowledge.

Many of the technologies that could lead to more widespread adoption of the Semantic Web for educational purposes already exist, but they are not sufficiently accessible or transparent to the majority of users and integration between systems remains patchy (Heath et al, 2006) While developer tools and environments aimed at expert users have existed for some time (see, for example, Beckett, 2001, on the Redland RDF framework), it is only with the development of robust toolkits such as that developed by the SIMILE project at MIT (see Mazzochi et al, 2005, and this project's Technical Appendix), easy-to use APIs and interfaces, and flexible and configurable representation and visualisation tools, that its potential can begin to be explored by teachers and learners.

From the perspective of the *users* (teachers and learners involved in case based learning), it is not the existence of the Semantic Web *per se*, or the affordances of specific elements such as digital repositories or XML/RDF that will determine whether learning outcomes are enhanced by the use of technology (Davies, 2007). Rather, it is the nature of the environments, tools and interfaces allowing the rapid and flexible visual presentation and manipulation of the kinds of complex data, interpretations and narratives that play important roles in case based learning. Visual representation of complex information in particular has been shown to support higher order and collaborative learning outcomes (Card et al., 1999; Hutchin, 1995) and there are also relevant studies of navigation of large information spaces (Ahlberg and Shneiderman, 1994; Spence, 1999; Zaphiris et al., 2002). The project will therefore engage with users through an extensive process of field research and enhanced participatory design (see Software Development Approaches and Project Activities).

For user requirements and expectations to be realised, data *providers* need to have access to tools allowing description, annotation and retrieval of data, together with robust processes which allow archiving and preservation, and enables sharing while maintaining data integrity reflecting methodological and ethical frameworks, and safeguarding confidentiality agreements. The associated data materials constructed by the research investigators are also

of great analytic, substantive and methodological use in their own right. Not only do they assist the user in using the raw data, they provide prime exemplars of research design, sampling, topic guides and analytic workings (see for example Corti and Bishop, 2004; Parry and Mauthner, 2005), and thus are of importance for learners engaged in case-based activities.

This project will address both the user and provider perspectives, and recognises that these roles will overlap. It will use tools developed by the SIMILE project as the basis of rich, user-centred online learning environments for case based learning, while also engaging with specialists in data archiving and digital preservation to develop the tools and processes to populate these environments. The UKDA has recently built a Fedora-based archiving system that will enable self-archiving and cross-linking of data. This system does not currently allow browsing or user-collation of objects, so the project will utilise this to present more complex collections and provide better linking to related resources. This project will be used by UKDA as the technical test-bed to ingest, present and preserve rich collections of data and their associated contextual and guiding materials.

This will create synergies between pedagogical agendas and developments, and long-term data sharing and visualisation solutions. The project is particularly timely as there are no current examples of this kind of integration of the work of teachers and learners (as well as researchers) with those of data providers such as the UK national archives.

4. Actor Network Theory: A Frame and a Guide

The project will adopt a frame that models practices and processes that works with complexity when: (1) research findings cannot be expected to stay stable over time; (2) replicating a technology, programme or research does not produce consistent findings; and (3) context and specificity (for example as a result of disciplinary ways of thinking and practising) appear to be as important as general patterns. The project is **not** conceptualised as a technological 'solution' to a pedagogical 'problem'; nor is case based learning simply a context for application of existing technologies.

A promising frame for our purposes is provided by actor-network theory (ANT). ANT avoids thinking about 'context as container' (Edwards and Miller, 2007) and reconstructs context as a set of relational connections, which are performed. It goes further by tracing associations between different *actants*, which include humans (users, developers, researchers and others), physical artefacts (e.g. visualisations, search and navigation tools) and theoretical and semiotic entities (e.g. learning outcomes, cases, and assessments), which are associated in textured relationships (networks). In ANT terms, the occasional stabilisations of networks produce and embody rules of engagement and rituals, ways of thinking and understanding, and materialisations in technology and language practices. For example, there are stable states before and after the enactments in the settings (see Table 1) when there is a flow of materials into the learning situation (e.g. course documents, learning resources, handbooks, and particular technologies) and out at the end (e.g. evaluations, assignments, examinations scripts, and projects). What is, of course, of interest to the project is the role of technologies, data sources and the cases around which learning is based: as actants, stabilisations and inscriptions.

ANT offers a language for observing, tracing and reassembling the 'ebbs and flows' and uncertainties of groups, facts, actions and understandings. For example, visualisations of complex information sets can be understood as inscription devices for engaging with a multiplicity of ways of understanding information and constructing new knowledge. Learning outcomes can be understood as a black box which is treated as a 'fact' where such closure suggest certainties that put aside contradictions and complexities which are otherwise

problematic. Fluidity then becomes a way of paying attention to 'ebbs and flows', so for example what is complex may be simplified and later resurface as a different type of complexity (Law and Mol, 2002). The Semantic Web, as a response to such fluidity, offers the possibility for users to "craft and play with different and alternative versions of reality", making the technology itself a mode of discovery and a set of tools for making and knowing new realities (Law, 2004, 98).

Such an interdisciplinary undertaking requires a theoretical framing of relevance to practitioners, social scientists and information/computer scientists as well as integrating with prior work on case based learning. Furthermore, ANT has also been applied in the course of studies of changes in teaching and learning practices and in the use of technologies in various forms of work, as these are configured, tailored, combined, adapted and mobilised in ways beyond those envisaged (Ciborra, 2002; Suchman, 2007). Actor-Network Theory (ANT) has been used to explore and demystify how and why the relationships between learning, technologies, and knowledge may be fragile and powerful, brittle and enduring, fluid and stable (Latour, 2005; Law, 2004), and provides us with a powerful and 'fit-to-purpose' set of research approaches which are described in Section 6, Research Approaches.

5. Research Questions

The previous discussions of pedagogical, technological and theoretical research agendas and frameworks frame the five broad research questions, which will be addressed over the course of the project. They inform the project objectives and will be addressed through the project activities specified in Section 16: Project Activities and Deliverables.

- **RQ1: What are the nature, scope and role of cases and case based learning across disciplines in higher education and their relationship to learning outcomes and expertise?**
- **RQ2: How do teachers and learners design, develop, describe and reconstruct cases, and how do these processes contribute to academic and professional outcomes?**
- **RQ3: What are the pedagogical affordances of using semantic web technologies in support of case based learning?**
- **RQ4: What new tools can be developed to allow users (learners, teachers, researchers) to access, adapt and manage their case based learning and that of others?**
- **RQ5: What are the theoretical framings for researching technology enhanced learning and informing interdisciplinary dialogues when knowledge, technologies and pedagogies are in a state of flux?**

6. Research Approaches

The project is conceptualised as an interdisciplinary learning environment within which processes of participatory design, co-configuration and collaborative analysis and interdisciplinary exchange, together with seminars, conferences and dissemination activities are envisaged throughout the life of the project. Engagement and dissemination activities are intrinsic to the project design as a whole, and the intention is to produce interdisciplinary and multi-voiced accounts in which intellectual and technical processes are closely interrelated.

Our identification of Actor-Network Theory as a framework for understanding the relationships between actants (teachers, learners, cases and technologies) in and across disciplinary settings also provides pointers toward the research and software development approaches, which will be adopted. We have drawn on approaches used in variants and

applications of ANT that have already proved influential in education (Fox, 2005; Nespor, 1994), Lifelong Learning (Edwards, 2002) the social sciences (Latour, 2005; Law, 2004); participatory design (Suchman, 2007), and agile software engineering (Fowler, 2001) and which all reflect "a shift from individualized, psychological approaches to understanding of knowledge-building to more social and cultural interpretations" (Edwards and Nicoll, 2007:187).

The conceptualisation of the project as a learning environment means that the distinction between sites of research on the one hand and sites of interpretation and analysis on the other, does not hold. All of the following will be seen as research sites and sources of data for subsequent co-interpretation and collaborative analysis:

- the teaching and learning environments, broadly conceived, to include not only classrooms, laboratories but other physical locations;
- the online environments in which the construction of cases takes place and the other virtual spaces in which research participants interact;
- design, envisioning and prototyping workshops, focus groups, user groups and informal spaces;
- project collaboration and conversation spaces including meetings, seminars, and user conferences.

Research approaches will include rich observation and description methods drawn from ethnomethodology (Garfinkel, 1967, 2002), adapted in the light of lessons learnt from research case studies (Garfinkel et al., 1981; Suchman, 2007; Haraway, 1991; Latour, 1987, 1996; Law and Mol, 2002). There will be a strong empirical focus and extensive data will be collected, to include accounts of actants, relations, and activity at the research sites, and, importantly, the materialisations and knowledge that flow in and out of each setting. These include technologies, equipment, information from databases and other sources, course documents, textbooks and papers, programme evaluations, representations in diagrams and schemas, interview with students and staff, evaluation data, and assignment).

Online data including the content of case studies, routine data such as server logs, and examples of the online discourse that accompanies the construction and reconstruction of cases, will also be collected and will provide a focus for discussion and co-interpretation with participants.

These processes of data collection and analysis will be enabled by the use of visual approaches such as video, audio and still photography. With these approaches, as with the others employed, validation and sense-making activities (Weick, 1995) such as focussed interviews, stimulated recall and critical incident analysis involving project participants will be of central importance. This will inform data collection and handling approaches – for example, the use of *Transana* as a means of rapidly selecting and provisionally categorising video and audio excerpts. This will precede sense making and stimulated recall activities, ahead of more detailed analysis of such data alongside the narratives which accompany it and which it engenders.

These 'black-boxing' activities will underpin both a characterisation of the role, nature and scope of 'case' across disciplines. They will also underpin an overarching framing of the role of technologies in support of case based learning using concepts from Actor Network Theory (for example: 'translation', 'mediation', 'multiplicity', 'fluidity', 'stability') and techniques for examining different forms of uncertainty and stabilisation (Latour, 2005; Law, 2004).

This in turn will allow an assessment of the affordances both of the specific technologies being used, but also of semantic web technologies and concepts more generally.

7. Software Development Approaches

The software development approaches employed by the project will involve participatory activities in which users are engaged not only in the generation of specifications and requirements (WP1, WP3), but also in the application, development and evaluation of software tools and other outcomes of the development process (WP4, WP6, WP7, WP9). A series of design activities will draw on a repertoire of participatory design techniques such as pedagogical scenario-building, paper prototyping mock-ups, simulations, story boarding, and cooperative prototyping (Bodker 1993; Gottesdiener, 2002); and extend these with techniques from interdisciplinary work on creativity at City University (Creativity_Events, 2003) and the experience of using advanced user requirements gathering techniques in the course of the JISC VRE programme (Carmichael, 2007; Laterza, Procter and Carmichael, 2007). 'Agile' software development approaches will emphasise user engagement over specific tools; working software over extensive documentation; and response to feedback over adherence to predefined plans (Fowler, 2001).

This approach maps closely to the JISC 'Users and Innovation Model' (JISC, 2006), which draws on participatory design and rapid development methodologies, and with which project members are familiar from the participation in the JISC VRE programme. Rapid prototyping of lightweight applications based on SIMILE tools such as *Exhibit* (see Technical Appendix) will allow several iterations through a cycle of "*observations of need - generation of solutions - technical development - testing and integration into context - implementation"*. These will be 'nested' within, and inform a longer-term development and implementation cycle involving the development of new tools, and middleware and digital repository integration into teaching and learning environments (WP2, WP5, WP8)

What is novel about the project's use of these development processes is the fact that iterative development, implementation, evaluation and reconstruction of problems is not only the approach to be used in software design, but is also an essential part of the pedagogical process to be supported and enhanced through the use of technology. The use of Actor-Network Theory as a framing device for the project as a whole also has the potential to inform the specific participatory design processes used in the project and to elaborate more general models of participatory design.

8. Research Settings

Preliminary engagement work at the project's research sites has identified six research settings in which learners engage in advanced undergraduate courses (Cambridge) and M-level and professional development courses (City) will be involved in case based learning. The settings represent not only a wide range of Higher Education activities but opportunities to investigate different conceptualisations of case-based learning. These settings are described in Table 1.

Table 1: Project Settings and Potential Applications of Project Technologies

Setting	Role of Cases	Description and Application of Project Tools
Cambridge **Plant Sciences** 3rd year undergraduate projects across Plant Sciences *Lead Academic:* Dr. Keith Johnstone	Experimental evidence is used to build cases in Plant Sciences. Any one case may be dependent upon a series of related and often contradictory other cases. Evidence can be utilised in a number of contexts including the synthesis of new relationships between previously unrelated observations; the prediction and testing of solutions to new problems; and the re-interpretation of previous work.	Theoretical underpinning of projects, which may be laboratory or literature based, is provided through formal lecture courses. Students work closely with academic staff and spend extended periods collecting experimental data and / or reviewing previous cases. They then synthesise their own case, which is produced as a written report, as well as in an oral communication to academic staff and other undergraduate students. The online tools will provide powerful methods for analysing patterns, omissions and relationships amongst published papers, experimental data, and the inter-relationships between the two. This will facilitate the generation and testing of new hypotheses, and thus the building of new cases. Resulting student cases will be archived and used as starting points for synthesis of cases in subsequent years.
Cambridge: **Engineering** 2nd year undergraduate module on the construction of earthquake-resistant structures. *Lead Academic:* Dr. Hugh Hunt	Characteristically, cases in engineering are focussed around specific examples or problems, although these may be instances of complex and multivariate systems; cross-case analysis is used to generalise to models and patterns that then have wider application. Expertise involves the application of existing models but the development and validation of new ones.	An initial framing lecture sets the context to be explored through a series of practical activities designed to reflect a different perspective on this broad and problem. Students then work independently on a short research project during which they are supported, but not directed, by teaching staff and also have access to online materials. Students are assessed on their work through a written report and a presentation. This sequence is designed as a precursor to more extended project work undertaken in the 3rd and 4th years of the course. Students will be presented with a range of data (geographical, seismological, structural, material), which they interrogate data in order to identify the most important factors contributing to structural failure. Comparison across cases allows the development of more generally applicable models, to be tested against other case data.
Cambridge: **Archaeology and Anthropology** 2nd and 3rd year undergraduates in courses on Ceramic Studies, Archaeological Science and Lithic Studies *Lead Academic:* Dr. Robin Boast	Case studies are used to look at how sites, materials and artefacts are classified, and how scholars have examined, classified, recorded and published particular sets of excavated material. This case study based approach it is most informative when the students are able to examine material from the collections by hand and are then able to see how that specific set of material was classified, recorded and published.	Students undertake case studies drawing together a wide range of evidence; for example, based on results of hydrological monitoring of a buried archaeological landscape introduced in lecture/seminar format and supported by field trip to the site, and example analyses of thin sections in the lab. They also look at how previous scholars have interpreted data, engaging with data, published literature and with the research activities of staff members. Staff members' research work is used to exemplify major issues in the field using taught classes in the lecture room and laboratory, as well as field-trips. Use of the online tools proposed by the project will allow students to engage with these rich data sources, using visualisation tools to locate data temporally and spatially, and to construct their own cases and interpretations. The opportunity to share data across a student group will allow multi-method and cross-case analysis.

City University: **International Journalism** MA students in two modules on International News and PrProduction *Lead Academics:* Prof. A. Monck H. Purdey	These courses are explicitly vocationally orientated and emphasise development of skills through practice. Student-generated cases are not only the focus of teacher input but also of extensive feedback from teachers and peers. Typically the emphasis on professional competencies is combined with a requirement for reflection to demonstrate abstraction, generalisation, and theorisation, illustrated by real-world experience of problem-formulation and resolution.	Detailed accounts of cases are presented using the 'Harvard' approach by leading practitioners who are then questioned by the learners. These events are discussion pieces which are one starting point for a new story. Teams of students take up leads and cover real stories and produce newspapers, run a radio station, broadcast on the internet, and produce television news programmes and multi-media websites. The pieces of journalism – news stories, feature articles, radio programmes, television clips, or podcast are assessed. Students will be presented with a range of data to accompany the case presented by the practitioners, and can of course draw on further sources as they build their news stories. Student projects will investigate the value of project tools in practical journalism; the tools may also be taken up in presenting complex research and ethical problems to different audiences and as a means of demonstrating pedagogical practices across the profession.
City University: **Maritime Operations and Management** MSc students in modules on Maritime Management and Ship and Marine Equipment Design Development and Research *Lead Academic:* Prof. P. Speare	This course targets learners who have extensive experience of working at the operational or middle management level, and who what to move into leadership and strategic management roles. Courses draw on expert perspectives in order to provide a broad and multidisciplinary experience emphasising theory into practice. Case studies are used as a starting point for simulations of complex real world projects on which students work in teams and on which they are assessed.	Students are prepared with series of specialist lectures. This is followed by allocation to teams based on prior experience. The teams are given four days to tackle a conceptual design problem (in the MEDDR course) and an emergency management response plan (in the MM course) based on authentic data. There are open-ended complex problems requiring extensive research, calculations, decision making, and judgement, and students must take into account classification, economic, environmental, inter-governmental, legal, operational, safety and technical aspects. On both modules the team are assessed by a presentation to a panel and an individual report based on the teamwork. Students might be presented via the online tools, with a range of data (technical, architectural, machinery and propulsion type, auxiliaries and layout, electrical system, personnel safety regulations, environmental standards, IMO guidelines) relating to the case studies in each module. Student projects will investigate extending the scope of case based simulations to other modules on the course and the research the possibilities for take up in pedagogical practices in the maritime sector.
City University: **Enterprise and Business Innovation** Students on Certificate in Enterprise Course *Lead Academic:* Dr. S. Dunn	The role of case study is contested in this context: there is a tension between model-based teaching related to generic management activities and living examples of entrepreneurship and innovation. Learners are keen to work with existing cases and in developing their own business or business idea as part of which they also develop new case materials based on their own experiences.	The certificate consists of a number of short course modules undertaken in the evening and students are drawn from both graduates and the local business community as such there is a good mix of learners in start ups and business improvement projects. Each module covers a particular aspect of running a small business – financial planning, marketing, innovation etc and students are assessed through the products they develop – including, for example, a marketing pitch and business plan. Students will be presented with a range of data relating to a specific enterprise. They will identify patterns in the nature of these businesses and progressively interrogate data relating to their development in order to identify the most important factors contributing to success or failure. By comparing their data with others' (including their own) they develop insights that can then be related to their personal experience.

9. Interdisciplinarity

The project will address the challenges of interdisciplinary working on a number of levels. It is a model employed in previous projects and programmes of research undertaken by members of the project team.

- Firstly, the individual research sites that provide the focus for data collection, development and intervention work are interdisciplinary in character, with new technologies and technology-enhanced practice providing a focus for interdisciplinary discourse and working between teachers, learners and technologists.
- Secondly, the project team will bring to bear on these a range of social, technological and educational perspectives as well as domain-specific models of knowledge and learning.
- Thirdly, the development of the semantic-web technologies, interfaces and applications will involve an extended and theorised discourse between educationalists and technologists in which both groups will have to engage with new approaches, theoretical frameworks and technologies.
- Fourthly, the cases that are generated will provide a basis for exploring with teachers and learners the conditions under which knowledge can be transferred, reconceptualized and operationalized across disciplines, educational settings and personal and professional contexts.

10. Alignment with TEL, TLRP and Other Research Programmes

The project aligns with several of the TEL programme priorities as well as with the priorities of the TLRP as a whole. Developments involving semantic web technologies foreground *personalisation* and *flexibility* in the rapid, customised and user-controlled assembly of content from diverse sources, and these themes are important foci of this project. However, the project can also be conceptualised in terms of a generative notion of *productivity*: for individual teachers (who will be better able to develop rich case-based learning activities) and for learners (who will be able to select and assemble the most appropriate sets of resources to support their learning needs), and for knowledge-creating communities. It will also develop models of knowledge production, representation and transfer which will contribute to the better understanding of sustainable economies for Technology-Enhanced Learning – one that aligns with a vision of teachers and learners as producers of pedagogical as well as disciplinary knowledge.

The project builds on and has been informed by prior work carried out within the Teaching and Learning Research Programme, in particular:

- The TEL 1 'Transforming Perspectives' project at Cambridge University which itself draws on concepts and approaches developed by the TLRP Phase II 'Enhancing Teaching and Learning' project (Entwistle et al, 2004).
- The SOMUL project, which has informed a view of university learning as a complex set of socially and organisationally mediated activities (Brennan and Jary, 2005).
- Several of the TLRP projects dealing with early professional learning which in Sfard's (1998) notions of 'acquisition' and 'participation' metaphors for learning, together with the development of identities and the role of 'professional ideologies' (Eraut, 1994).
- The social learning theories explored by the TEL1 'Personalisation of learning' project at City University which align with the work of a number of TLRP projects which have drawn on ideas from actor network theory.
- Members of the project team (Edwards, Carmichael) participated in the TLRP seminar series ‘Contexts, Communities and Networks: Mobilising Learners' Resources and

Relationships in Different Domains' and this series, together with the publications which emerged from it (e.g. Edwards and Miller, 2007) provide a good starting point for the theoretical explorations which will play a part of the project and its associated seminar series.

The project also aligns with emerging thematic analysis from TLRP projects in that it too attaches high importance to the integration of prior learning, recognises the blurring of the distinction between formal and informal learning, and promotes the active engagement of teachers and learners with authentic and valued knowledge (TLRP, 2007).

The project will address issues which align with priorities identified in key strategy documents such as the ESRC/EPSRC/E-Science E-Learning Research Agenda and the 'Computer Challenges' review from the e-Science Programme: most obviously, the need for collaboration across learning facilities to support archival repositories of community memories and learning histories that preserve not only content but information about its provenance and epistemological and methodological underpinnings.

The project also aligns well with several of current and emerging British Computer Society 'Grand Challenges'. The most obvious match is the 'Learning for Life' challenge, with its concern to develop technologies to support individual and group learning across formal and informal contexts. The project will demonstrate how these can be elaborated in specific disciplinary contexts and how appropriate technologies can contribute both to individual learning and knowledge cumulation. The project also aligns with the 'Memories of Life' and the 'Bringing the Past to Life for the Citizen' challenges, which stress the importance of supporting interpretation within sufficiently rich and flexible contexts to allow for individual meaning making. The key areas for development within these challenges: (streamlined data collection and manipulation, modelling and visualisation systems, and development of an integrated semantically-enabled infrastructure of tools and formats) are closely related to the technological processes, and teaching and learning outcomes envisaged for this project.

Finally, the project will engage in dialogue with other projects and programmes including: the JISC (repositories, e-infrastructure, e-pedagogy); the ESRC e-Social Science programme (both technological and 'social shaping' strands); and ESRC Research Methods nodes and RDI programmes concerned with related and relevant research approaches. It will also have significant 'practitioner' focus, with teachers, instructional designers and content developers all being important beneficiaries and users of the approaches developed, thus ensuring opportunities for the project to engage with BECTA; relevant HEFCE Centres for Excellence in Teaching and Learning; HEA subject centres; SHEFC, SEED and the Scottish Applied Education Research Scheme and its successors; and professional and subject associations.

11. The Project Team

The project brings together a well-qualified and experienced research team with a successful track record of methodological innovation, development, research and publication across the computer and information sciences and social sciences, including in the context of interdisciplinary working (see attached *curriculum vitae)*.

The team emerged from the synergies established between two of the ESRC/EPSRC TEL Development Projects (2006-2007): 'Transforming Perspectives: Technologies to Support Teaching and Learning of Threshold Concepts' (Carmichael, Johnstone); and 'Personalisation of learning: constructing an interdisciplinary research space' (Solomon, Patel, Solkin). These projects helped establish the research agenda to be addressed in this new TEL proposal, confirmed the effectiveness of participatory approaches to research and development and provided a space for the development of user engagement and dissemination strategies. Like

the new project, these two development projects viewed themselves as expansive and generative learning environments in their own right; 'Transforming Perspectives' has now been evaluated and was described as "more than meeting its original objectives and through its seminars where cross-discipline concepts were explored, developed a model of practitioner research in HE".

The joint project team has been extended to include additional and complementary skills and experience, and to provide a broader ranger of professional, academic and technological expertise and to offer a range of disciplinary and theoretical perspectives:

- Research and development of teaching and learning in higher education and lifelong learning, including technology enhanced learning and distance education (Carmichael, Johnstone, Patel, Solkin, Edwards, Solomon)
- Software design, development and evaluation (Corti, Carmichael, Bolton, Patel)
- Digital archiving, preservation and secondary analysis (Corti, Carmichael)
- Teaching and learning with multimedia case study (Walker)
- Professional learning and learner identities (Edwards, Solomon, Patel, Solkin)
- Technology-enhanced research and research capacity building (Carmichael, Corti)

With the involvement of the project consultants and partners, the project offers an opportunity for social scientists, information and computer scientists, disciplinary specialists and technology service providers to work collaboratively across a range of pedagogical settings.

Project members additionally have experience of management and facilitation of the kinds of activities described in the project plan including conferences, workshops and seminar series; the commissioning of special journal editions; user engagement and dissemination activities and engagement with policymakers at different levels.

The project will be directed from the Centre for Applied Research in Educational Technologies (CARET) in Cambridge. As well as supporting teaching, learning and research across the university, CARET is a member of the Sakai Consortium (http:/www.sakaiproject.org) which is developing an open-source virtual collaboration environment; a member of the TETRA group (along with Oxford University, UHI and the University of Hull), and of the Association for Learning Technologies Lab Group. It is a partner in the HEFCE CETL for Reusable Learning Objects and has participated in the JISC VRE and Repositories programme; in the ESRC Teaching and Learning Research Programme and QUADS scheme, and in other projects funded by HEFCE/HEA, JISC and the AHRC. It maintains close links with the University Library and Computing Services as well as with departments, colleges, research centres and other central units of the university. The research and evaluation group at CARET (headed by Carmichael), plays a central role in research and development of pedagogical practice at the University through its involvement in a HEA-funded Pathfinder Project, the Cambridge-MIT Institute-funded Teaching for Learning Network (co-directed by Carmichael and Johnstone), which supports practitioner research within the university, and a range of other internally and externally funded activities. CARET has well-established project management procedures in place and maintains the infrastructure to support major, multi-institutional research and development activities.

12. Consultants and Project Partners

Two groups of consultants will provide technological support, services and training to the project:

- The SIMILE project based at the Massachusetts Institute of Technology will support the implementation of their Semantic Web tools and their integration with digital repositories and other elements of the projects' technological infrastructure. SIMILE will also train project staff. McKenzie Smith, Director of SIMILE, will be a member of the project steering group.
- Consultants from the Economic and Social Data Service of the UK Data Archive at Essex will provide training, advice and services related to the development of self-archiving repositories, metadata schemas for the description of case data, and system integration.

The project already has good working relationships with these groups, through a number of collaborative projects between Cambridge and MIT and through CARET involvement in the ESRC QUADS scheme.

The Faculty of Education at the University of Technology, Sydney will be involved as a project partner. Professor Nicky Solomon (*curriculum vitae* attached), formerly Head of Education and Lifelong Learning at City University, will contribute to the project as a member of the seminar series and to analytical and theorisation activities, particularly around issues of learner and professional identities. Additionally, this partnership with the project would be the beginning of an international relationship. It will formalise links between UTS and City University (which have similar profiles in terms of mission, student body and commitment to professional learning) and will provide the necessary basis for developing a further ESRC and ARC international collaborative project application, and then ultimately an ARC Discovery application, where City University and other UK-based researchers would be international partners and researchers.

13. Project PhD Studentships

Two project PhD Studentships are proposed (see attachments). These studentships will help the main project to fulfil its aims of charting pedagogical, research and development processes, but will focus on contrasting curriculum areas and on the nature of the cases and the technologies themselves. The students, who will be members of the project team, will have rare opportunities to undertake interdisciplinary research and will be supported by supervisors drawn from across the project team.

14. Steering Committee, Seminar Series and User Conferences

The conceptualisation of the project as a learning environment has implications for the nature and role of the project steering group. This interdisciplinary group, as well as advising the project team, will form the core of an invited seminar series to run concurrently alongside main project activities, the latter providing 'points of focus' for interdisciplinary engagement with the pedagogical, technological and theoretical issues arising from the work of the project. Three of the seminars will be extended into 'User Conferences' in which project participants will work together, and with seminar participants, to explore emerging themes from the research settings.

This organisation (used very successfully in the 'Transforming Perspectives' TEL Development Project) allows interdisciplinary dialogue and knowledge construction between teachers and learners from participating research settings; between these participants and seminar series contributors from a range of disciplinary backgrounds; and across disciplines as seminar participants offer their varied perspectives on the work of the project.

The following have agreed to act as members of the steering group and to participate in the seminar series, and in consultation with the project team will identify other seminar

participants: Professor Grainne Conole (Open University); Professor Harry O'Neil (University of Southern California); Professor Ray Land (Strathclyde); Professor John Elliott (UEA); MacKenzie Smith (MIT); Dr. David Good (Cambridge and Cambridge-MIT Institute); Professor Jonathon Raper (City University), Dr. Heidrun Allert (Hagenberg Campus, Upper Austria University of Applied Sciences).

The provisional programme of seminars and conferences is as follows:

Table 2: Seminar and User Conferences – Provisional Programme

Date	Event	Focus of Activity
Oct 2008	Project Launch	Introductions, position pieces and possibilities; expectations of project participants
Jan 2009	Seminar and User Conference	Responses to prototypes and emerging requirements; participant researcher activities
Jun 2009	Seminar	Actor Network and Case Study: relationships, synergies and challenges
Jan 2010	Seminar	Multiple Identities in Educational Research: teacher, learner, researcher, professional?
Jun 2010	Seminar and User Conference	Cases of Cases across the disciplines: the nature scope and role of case based learning
Jan 2011	Seminar	The Semantic Web: diasporas, actants and agency
Apr 2011	Developer Conferences	Semantic Technologies for the Development of Teaching and Learning Environments
Jun 2011	Final Conference	'Conversations about cases', stories of success and failure, lessons learned and where next

15. Project Management, Meetings and Communications

Project duties and responsibilities and the project's internal communication plan will take into account the distributed nature of the project team and the importance of maintaining regular contact as well as providing opportunities for discussion and collaboration across sites, settings and disciplines.

Meetings: Site meetings will take place weekly between investigators and research associates at each site, with other staff attending as appropriate. At key times in the project (such as the summer of 2009, when reviews of prototyping processes and specification of technical development will take place), these will take the form of extended meetings involving key participants. The team concerned with technical development (Carmichael, Corti, one research associate and one student, together with consultants from MIT as appropriate) will establish their own more flexible meeting schedule to run alongside site meetings.

Whole team meetings involving all investigators, research associates and students will take place approximately every 4-6 weeks at either City University or Cambridge University. During the later stages of the project, extended residential meetings will take place to allow the entire project team to work intensively on analysis, reporting and dissemination activities. The principal investigator (Carmichael) will also have quarterly meetings with project

managers at CARET and the research services division at Cambridge to review budgetary and resource allocation issues.

The project steering group will meet at 6-monthly intervals, these meetings coinciding with research seminars and user conferences. The PhD students will establish a meeting schedule, which satisfies both the expectation that they contribute to and are supported by the wider project, and the requirements of their institutional PhD programmes.

Internal Communications: The meeting schedule outlined above will allow systematic reporting from site and technical teams to the whole team. The principal investigator will report on behalf of the team and the project management group to the steering group. The provision of a tiered structure will allow oversight while encouraging autonomy and responsiveness on a per-site and per-setting basis. As the project progresses, it will also provide a support structure for collaborative writing and peer review of project outputs, with the whole team and steering group providing first audience for emerging analysis and potential publications.

Prior experience of large and distributed projects has demonstrated the value of a project 'handbook' (either in paper or online form), bringing together project documents, details of expectations of project members, meeting schedules, reporting procedures, ethical frameworks and publication procedures. This will be developed early in the project and periodically reviewed.

The project will use a range of network tools and platforms for communication and management. The Sakai virtual research environment developed and hosted at CARET has been used to good effect in the support of other multi-site projects and activities (Laterza, Carmichael and Procter, 2007) and has the added advantage that it will also be used as the platform for the user conferences and for other user engagement activities. It provides scheduling, announcement, email archive and discussion tools as well as resource storage and a wiki environment for collaborative writing and robust and sustainable project management processes have been established.

Technical development will also be supported through the use of a JIRA issues tracking system hosted at CARET. This has been trialled across other development and research projects at CARET and has proved to be an effective means of maintaining communication between developers, researchers and 'users' as well as allowing the identification and prioritisation of areas for development.

All of the participating institutions have access to video conferencing suites to allow team and steering group members to participate when they are unable to attend meetings; and to allow communication with MIT and the project partners at UTS in Australia.

16. Project Activities and Deliverables

Project activities are organised in three overlapping phases, each with three work packages. It is expected that some research settings with time constraints and commitments (such as existing assessment systems or patterns of student engagement) may develop different patterns of implementation and application in Phases 2 and 3. Key deliverables are highlighted in bold and map to the objectives of the project (as set out in the JES application).

Phase 1: October 2008 – June 2009

This phase will involve coordinated working on the part of investigators, research associates and participants as the potential of the tools is explored and emerging user requirements are gathered and assessed. Key events and periods in this phase will include: an extended project

team meeting and launch event (Oct 2008); a user conference and associated seminar to review emerging patterns of use (Jan 2009) and a period of close collaboration between the site and technical teams to prioritise technical development priorities (May – Jul 2009).

WP1: Engagement, Requirements Gathering and Prototype Development

An initial engagement process led by the Site Teams in each of the research settings together with early whole-project activities including the project launch event will provide a basis for early fieldwork, understanding requirements and rapid prototyping using lightweight SIMILE project tools leading to a more fully scoped plan for student engagement and pilot work. These **requirements, prototypes and plans** will provide a focus for the first user conference in Jan 2009.

WP2: Repository and Middleware Development

In parallel with WP1, the Technical Team will develop a robust instance of a digital repository with interfaces to the Longwell browser instances. These will be **technical demonstrators based around existing data sets** generated by prior projects. **Self-archiving, annotation and data description processes** for user generated data and metadata will be developed based on current tools used by ESDS to populate their Fedora digital repositories.

WP3: Tool, Interface and Schema Specification

The user requirements and prototypes generated during WP1 will provide the basis of **technical specifications for new tools and interfaces** to middleware, repositories and other data sets and services. These will be designed to be simple yet flexible tools, accessible and usable by teachers and learners within project settings in the course of case based learning. Site and Technical teams will work together with participants to hone these requirements and consultants from the SIMILE project will advise and support in this process. Consultants from ESDS will use the rich accounts and user requirements to develop **a metadata schema for repository content** capable of representing case content across settings and user generated content.

Phase 2: January 2009 – August 2010

This phase will include extensive fieldwork, envisioning visualisation workshops with learners and teachers. This will be alongside main implementation of the technologies with groups of learners during the academic year 2009-2010 and the development of visualisation demonstrators. New tools and interfaces will be developed to integrate repository, middleware and user interfaces. The user conference (Jun 2010) will lead to the publication of a first set of project briefings and tools and interfaces developed by the project will be released to the developer community (Summer 2010).

WP4: Implementation and Application 1

Pilot and illustrative cases will be used as starting points for use with cohorts of students and teachers, who will be supported in their use of the learning environments in order that they can engage with and build cases in the course of their own learning. Researchers will document teaching and learning activities, independent work by learners and assessment processes using a range of ethnographic, observational, multimedia and interview methods. ANT will be used to analyse and theorise the data. This will generate **rich accounts of case construction** and input into further collaborative envisioning/visualisation in interface design workshops bringing together developers, teachers, students and researchers.

WP5: Tool and Interface Development

Research Associate C will develop the technical demonstrators generated in WP 2 into 'live' Longwell instances for each research setting with associated digital repositories and interfaces to other appropriate data sources. As students generate cases and case data in Exhibit, these will also be ingressed into the more scalable and robust server-side applications, in the course of which participants and developers will **evaluate ingress tools and metadata schemas**. An **interface to the user annotation tool** (WP2) will be developed allowing extension of the data presented through the Longwell instances. **Other new tools and interfaces** will be developed according to the specifications established in WP3 and these will be piloted first with existing data sets, then with user-generated data and then with teachers and learners as they elaborate the cases they build in the course of their work.

WP6: Review, Documentation and Release 1

The summer of 2010 will be spent reviewing the development and application of technological tools by teacher and students; the processes by which cases were developed, elaborated, interrogated and assessed. Particular attention will be paid to discipline-specific and more generic workflows in order to develop **further RDFizers and conversion utilities, validation procedures and metadata schemas** in order to streamline and integrate case construction processes. New tools and interfaces will be documented for release to the developer community and the project participant community ready for WP7. Focus groups and the subsequent user conference will provide opportunities for discipline-specific and interdisciplinary dialogue about the nature of cases, cross case comparisons and the use of the technologies. These will document collaborative interpretations by seminar participants, the project team, teachers and students.

Phase 3: January 2010 – September 2011

During this phase, the project will continue to support and research implementations of technologies with groups of learners, focussing on reuse and restructuring of previous cases by subsequent cohorts. It will also track learners engaged in Phase 2 during their subsequent study or professional practice to investigate the reach and impact of their involvement in case based learning on their subsequent activities. Integration of repository, middleware and client-side software will be completed with a release of new tools, systems and full documentation by June 2011. Other key events include a user conference (Jan 2011); two developer conferences (April-May 2011) and final project conference (Jun 2011).

WP7: Implementation and Application 2

A second cycle of case development and application will be researched, with two points of focus. The first of these are **accounts of engagement with, development and reconstruction by new cohorts of students with cases** constructed during WP4 (and which will be studied using a similar set of research approaches); and secondly the application by learners of case construction approaches documented in the course of WP4 and WP6 which will be studied through an **initial survey**, **detailed follow-up studies** of a small number of students drawn from across sites and settings, and a final survey designed to explore the **impact upon attitudes, activities and identification with disciplinary practices of project participants**.

WP 8: Full integration of Repository, Client-Side Tools and Interfaces

The integration of self-archiving repository tools and client-side tools and interfaces will allow the permanent preservation of data and cases, as well as providing mechanisms for

ingress, annotation, and expression of these using a set of tools that extends the currently available repository and SIMILE tools. Working with MIT consultants, the technical team will develop, pilot and document **environments providing teachers and learners with the combined affordances for long-term preservation of digital repositories; the collaborative and annotation tools characteristic of social and community software platforms; and the expressive and flexible search and visualisation potential of SIMILE project tools**. These developments and the results of pilot implementations drawn from WP7 will be presented at the developer conferences planned for the spring of 2011.

WP 9: Review, Documentation and Release 2

The final phase of the project will review not only the new learning environments and the cases developed within them, but also the new understanding of the dynamics of collective and individual learning through the participatory design of new environments, cases and representations. **Accounts which closely integrate intellectual and technological development, and in which knowledge creation and cumulation processes are richly described** will provide both a focus for analysis by social scientists but also highly contextualised user requirements for technologists and software developers. **Software, indicative content and development processes will be stabilised and fully documented prior to release**; given the rapid development envisaged in the course of the project, care will be taken to provide detailed technical documentation aimed at system administrators; documented code for software developers; and tutorials aimed at users of the environment who are primarily concerned with developing case based learning resources.

17. Risk Analysis and Amelioration

Five major areas of risk have been identified through discussions within the project team and others engaged in similar interdisciplinary research and development projects. A full risk analysis will be conducted at the commencement of the project and will be periodically reviewed and reported as an element of the annual report. These areas of risk, and the steps taken to ameliorate these are:

Appointment of suitable staff: this is not foreseen as a major risk; participating institutions have excellent reputations and extended networks through which they advertise vacancies; as a result posts attract large numbers of highly qualified staff from the UK and overseas. Research associates will be appointed subject to usual institutional probation procedures and PhD students will be subject to institutional progress and upgrade procedures.

Sustained engagement of participants: the engagement of potential participants (including some who have worked collaboratively with project investigators in previous projects) at the proposal stage has reduced risk in this area (the letters of support attached indicate high levels of commitment to the projects aims and approaches). Engagement in research settings and prototyping from early in the project lifecycle will also maintain levels of interest, as will the project's sensitivity to disciplinary contexts and it interest in and support for institutional 'embedding' of project approaches and outcomes.

Technical development of software tools and environments: The identification of the SIMILE toolkit, and the use of other existing robust frameworks (Fedora, Sakai) will provide a basis for rapid development while at the same time providing enough flexibility to allow innovation and creativity, and opportunities for the identification and development of new tools, services and interfaces. The technologies to be used while novel are well supported both by their original developers and have active international developer and user communities.

Sustained and constructive inter-site and interdisciplinary dialogue: this poses a challenge for a project of this size, and for interdisciplinary working in particular. The project builds on the experience the two TEL1 development projects and other projects and will commit significant resource to building interdisciplinary working arrangements. Resources have been allocated so as to provide time and space for dialogue and focussed enquiry in the course of initiation events, user and developer conferences, and the interdisciplinary seminar series. Other strategies to encourage interdisciplinary activity include the co-location of researchers and developers and the establishment of interdisciplinary panels for the project students. More broadly, the selection of a sufficiently broad theoretical framework (Actor-Network Theory) will support engagement of project participants from computer/information science and social science as well as disciplinary specialists.

Unforeseen Institutional and Policy Developments: it is conceivable that changes in funding regimes and other policy developments during the lifetime of the project might have some impact on institutional commitment to, and student enthusiasm for certain courses or pedagogical approaches. While this might be an interesting challenge and focus for research, major changes are unlikely to adversely affect the activities of the project given the level of institutional support - for pedagogical development in general, for technology-enhanced learning and for the project in particular – evidenced in the letters of support attached.

18. Dissemination Activities

In order to engage with the widest possible audiences the project will identify conferences and other events through which they can engage with education and technology audiences. In addition to conferences primarily concerned with technology enhanced learning (ECSCW, CAL, ALT-C, JISC), we have already identified major conferences in which Technology-Enhanced Learning, Instructional Technology or Educational Technologies strands provide opportunities to disseminate to the TEL community. These include EARLI (2009 and 2011) BERA (annually) and AERA (annually). Recent initiatives to forge links between E-Science and Computer Supported Collaborative Work communities (the project team was represented at a recent seminar at the ECSCW conference) offer opportunities to explore methodological approaches and innovations and provide additional networks in which the project would participate.

Relevant European Initiatives such as the recent FP6 Knowledge Network on the Semantic Web (FP6-507482), of which a member (Allert) has agreed to participate in the project seminar series, EC-TEL Conference and Kaleidoscope Conferences also represent important international dissemination opportunities, as would the ASCILITE conferences where project representation would draw on and potentially be led by project partners at UTS in Sydney. More specific education conferences on education (SRHE, HEA and Lifelong Learning) would provide a means of engaging with the educational audiences, and participants in research settings would be encouraged and supported in engaging with disciplinary communities (for example through subject journals, HEA subject centres and other professional institutions) using links already established through existing projects. For example, the Centre for Research into Lifelong Learning at Stirling will hold an International Conference in June 2009 to which the project would make a contribution with attendees also contributing to the June 2009 user conference of the project. Similarly, the project will have contributions to make to debates currently taking place at specialist technology conferences such as the Computer Assisted Data Analysis Software conferences run by the CAQDAS network and the Visualisation in the Arts (EVA) conferences organised by the BCS. The project will also engage with TLRP/TEL programme activities such as conferences, seminars and inter-project collaboration.

Within the participating institutions, the research settings themselves provide means of project dissemination both within the institution (through the Tripos system at Cambridge and across modular courses at City); through bilateral arrangements (such as those between the Faculties of Engineering at Cambridge and MIT); through established networks (the City Certificate in Enterprise is part of an EU FP7 'Leonardo' project and the Marine Operations and Maritime Management course is part of a 'Erasmus' Mundus Course Network with four other European universities); and through links with employers and other stakeholders in courses.

The Project Seminar Series and User Conferences also represent significant dissemination opportunities and the project will develop a proposal for a special edition of an appropriate academic journal based around the seminar series. The second and final user conferences will be run as 'online conferences' in addition to the face-to-face element, with the Sakai virtual collaboration environment being used to provide:

- An interactive 'poster session' based on the cases developed by project participants
- Abstracts, papers and presentations online for further discussion
- Online tutorials based on the technology workshops
- Webcasts of keynote presentations
- Mailing lists for subsequent communication and project updates

The content of the online conference will have value in their own right (the online tutorials, for example, being of value to members of the established SIMILE and Fedora user communities), but the online environment will also act as the basis of a sustainable user community of teachers and learners engaged in technology-enhanced case-based learning.

The project recognises the work done by TLRP in engaging with practitioners and policymakers and will use approaches established by the programme. Articles for academic journals will be complemented by submissions to professional publications and subject specialist outlets such as the online journals, newsletters and other media produced by the HEA subject centre network. A 'user community' newsletter will maintain links with users across research sites and settings, as well as providing a first outlet for emerging findings, reflections and project news.

Resources have been set aside for the production of a series of 4-page, 1500-word research briefings modelled on those produced by the TLRP. A public website will be established with information about the project and links to project outputs and to online conference content.

Software tools and interfaces will be distributed under and appropriate BSD-style licence and case content itself will, where appropriate, be disseminated electronically under an appropriate Creative Commons licence, taking into account ethical and IPR issues. Case studies selected for public dissemination might be made available as structured repository content publicised using the Open Archive Initiative Protocol for Metadata Harvesting (OAI-PMH); as suitably packaged standalone Exhibit applications; and as IMS Content Packages for integration into virtual learning environments.