THE
ROBERT GORDON
UNIVERSITY
ABERDEEN

Acknowledgements

This report was written by Jenny Ure, Dr. Julian Malins, and Lesley Cullan.

The research documented in this report was funded by the Scottish Higher Education Funding Council under their Strategic Change Initiative. The Robert Gordon University, Gray's School of Art provided the infrastructure and other resources to allow the research to take place. The staff and students of Gray's School of Art are thanked for their support and for providing essential feedback to the research team.

1

Particular thanks are due to the CAL team:

Dr. Julian Malins – Project Leader

Jenny Ure - Research Assistant

Lesley Cullan - Design and Development

Chris Braithwaite – Design and Development, and Web Manager

Simmone Davidson - Administrative Support

•

Ian Pirie - Advisor

Prof. Eric Spiller - Project Management

Prof. Jim Penman - Project Management

Gillie Reith – Project Officer

•

The research gratefully acknowledges the work undertaken by the following consultants:

Commercial Technologies Limited

Sunil Vishin

Dr. Iain Burt

Richard Dyce

•

2

IN THE GLOSSARY:

- Virtual Learning Environments (VLEs)

- Constructive Learning

- CSCW

- Intranet/Extranet

- GUI

- HCI

- VDS

- CoP

studiospace

Glossary

Key terms used in this report are given so that the interpretation intended is clear.

Virtual learning environments (VLEs)

Sometimes known as Managed Learning Environments (MLEs) or Integrated Distributed Learning Environments (IDLES). The term refers to a range of web-based tools, which are integrated to support teaching, learning and often course management through a web site. In this case the VLE is 'studiospace' accessed via the website http://www.studio-space.net

In the original SHEFC documentation the virtual learning environment developed was referred to as the 'CAL Design Framework', however preference has been given to the more generic term 'Virtual Learning Environment'.

Within the report this will be referred to as the 'studiospace' Virtual Learning Environment, or simply 'studiospace'.

Constructive learning

Based originally on the work of Piaget, it has developed as social constructivism in the work of Vygotsky, and has been extended to web-based contexts. It is based on the premise that learning is socially constructed on the basis of individual and shared experience. This has implications for the design of effective learning environments, in that it requires contexts that allow representation and sharing of experience, and opportunities for internal dialogue (reflection) and dialogue with others. This is the basis for the 'meaning-making' or 'knowledge-building community' concept underlying recent web-based learning environments.

CSCW

Computer supported, collaborative working has a long history, and provides a key element of constructivist approaches to learning. As such it has highlighted (a) what actually constitutes collaboration as opposed to mere cooperation, (b) how the collaborative process of meaning-making can be researched or supported and (c) how this can be supported on-line through web-tools   .

Intranet/Extranet

Users networked within a department or an organisation to shared information, processes and possibly a virtual learning environment, may be said to be on an Intranet. Where this extends to include other users in other locations on

3

the same set of shared spaces, it is called an Extranet. Both terms assume a degree of restricted access and managed information i.e. information is targeted towards the individual user.

GUI

Graphical user interface. Increasingly virtual teamwork through shared interfaces and virtual 'spaces' is becoming the norm for working professionals, particularly in applied fields such as product design and manufacture, engineering, medicine and education. The design of GUIs to meet the cognitive and organisational needs of users is a rapidly expanding area of development.

HCI

Human Computer Interface refers to the design of both standalone and shared interfaces. The design of these depends on an understanding of information processing, cognition, domain knowledge and the social and organisational processes and transactions that they are intended to support.

VDS

Virtual Design Studio. This is a rapidly expanding field now that rapid prototyping software can be shared on-line between the different groups involved in the design of artefacts, products, architecture, engineering concepts etc. Design, in this context, can be the design of artefacts and products, but also the design of manufacturing processes, the mapping of information and knowledge (knowledge architecture) or the modelling of processes (simulation).

The use of visual scaffolding or metaphors to map, share, explore and manipulate real or abstract information and concepts across a virtual team is what makes GUIs and VDS a powerful new tool for supporting the 'knowledge-building' community in education and business.

CoP

The term 'community of practice' has been an integral part of the development of virtual learning environments in America and is now influencing the perception of these environments elsewhere. Literally, it refers to the extended 'networked' community who use the environment, whether as a shared space, an Intranet, an Extranet or via the Internet.

Conceptually it refers to the implications of collaboration for a community with shared interests - generation of new concepts or products, sharing of resources, sharing of best practice, critical analysis, professional updating etc.

Contents

5

6

8   DISCUSSION

9   CONCLUSION

10   REFERENCES

studiospace

Executive Summary

REVIEWING THREE GENERATIONS OF VLES

A review and categorisation of learning environments across professional disciplines and organisational contexts suggested three 'generations' of VLEs (Virtual Learning Environment), premised on different educational paradigms.

The current trend for networked 'communities of practice' is premised on the belief that knowledge is socially constructed and mediated by dialogue with peers through shared experience - a constructivist model.

The studiospace VLE developed during the CAL project, combined collaborative knowledge-building with knowledge capture and re-use as an ongoing, 'generative' system for the networked community.

Corporate VLEs and Intranets increasingly use these to mediate social and technical processes that can add value to the networked community in an increasingly competitive market.

IDENTIFYING TECHNICAL, EDUCATIONAL AND ORGANISATIONAL NEEDS

Effective use of networked ICTs depends on the match to users' needs. The design of the studiospace VLE for learning and teaching in Art and Design was built around the needs of learners in particular, but also other stakeholders. (See Appended tables for full list of specifications).

Art and design is a discipline which requires shared visual spaces for collaborative design, and a range of web-based, multi-media capable tools that can be accessed, authored and shared by remote users at anytime and from anywhere.

An increasing number of disciplines, such as engineering and knowledge management, work in virtual teams on shared graphical user interfaces. The collaborative visualisation of information and processes is arguably the new 'literacy' among networked professionals, from engineers to knowledge managers.

Technical needs emphasised inter-operability, scalability and cross platform web access.

Educational needs emphasised collaborative, constructivist and visual modes of learning in a range of media, and the use of shared spaces for multi-disciplinary design by virtual teams.

Organisational needs such as student record-keeping, recording of assessment and course administration emphasised the need for an integrated 'systems' approach, and also the need for a multi-media-capable knowledge-base for the capture, management and re-use of inter-operable resources for teaching, learning, course authoring and support.

DEVELOPING AND IMPLEMENTING THE SYSTEM

The design and evaluation of software was determined by the extent to which the system supported the needs identified in addition to factors such as cost, compatibility, ease of use, and robustness.

An action research approach was adopted in the involvement of a range of stakeholders to actively identify the needs and implement the change process.

A systems approach was used to identify where shared interfaces were required, and how different processes could be integrated most cost-effectively to meet the different requirements of students, staff, administrators etc.

As the system evolved, it became apparent that the potential of the system could not be assessed independently of the processes and perspectives of the wider organisation with which it interacted. This requires both top-down and bottom-up strategies as Australian and Canadian reviews suggest, and relates to the 'systems' approach in organisations described by Peter Senge.

The studiospace system combines web-based tools and interfaces, supported by linked databases (knowledge-base) to support a wide range of educational, organisational and professional processes detailed in the report. These encompass the role of VLE and MLE (Managed Learning Environments) as well as providing a basis for supporting and evidencing professional and organisational development.

EVALUATING THE COSTS AND BENEFITS

Both the development and evaluation of the system was an iterative process involving stakeholders in the change process using an action research model.

The future implementation of some of the functionality is dependent on the willingness and commitment of staff within and beyond the Faculty to review processes and practices that directly affected their work and workload.

The timing, as systems were under review across the faculty, was fortuitous for the project, since it was seen more as a means of working towards a potential solution to a perceived problem, rather than a challenge to the existing status quo.

The benefits where change was planned were immediately evident in terms of the potential for enhanced support for new courses and new projects involving remote authoring or delivery, as well as in-house use of technology-rich modules such as the Design for Digital Media course.

Parts of the system are already being adopted in a number of current and planned initiatives, and are to be incorporated as part of the development of a new Faculty Intranet.

The potential for saving of staff time on repetitive tasks involving demonstration of technical processes and administrative processes is balanced by the need for additional (under-estimated) requirements for technical support, database maintenance and data in-putting.

Staff development is another area that should not be underestimated, both in the use of the system and the development of effective online course content. This is an issue already identified in the VATS and NetCulture projects funded by SHEFC to look at use of ICTs in learning and teaching.

The increased need for staff and student access to computers is a significant additional hardware/software cost which is often under-estimated. In an institution where there is a commitment to the benefits of networked teaching and learning this can be accommodated. However it suggests that implementation of a VLE before this institutional process has been championed and sufficiently engaged in would be difficult to sustain.

'Soft' processes such as personal and professional development may benefit from the greater transparency, currency and collaborative access to current information and resources and this has implications for organisation seeking to evidence quality assurance in teaching and learning.

12

IN THIS SECTION:

studiospace

1 Background to the Project

'Design is a complex, collaborative process. Rarely can a designer imagine, develop and describe a solution to a design problem without interacting and collaborating with numerous other people such as the client, suppliers, other designers, manufacturers etc'

Maher et al 1995

1.1 NETWORKED TECHNOLOGY IN THE PROFESSIONAL ENVIRONMENT.

13

Designers, and product designers in particular, work in collaborative cross-disciplinary contexts involving engineers, manufacturers, suppliers, researchers and users in virtual teams. Art and Design training is also increasingly distributed and cross-disciplinary.

The research project responds to the new needs of training providers and the new contexts for which professionals in Art and Design are now being prepared, and looks at the design and evaluation of virtual tools and environments that can support:

- Collaboration in visual media
- Administrative processes
- Generation, capture and re-use of knowledge and resources
- Professional and organisational development

As markets become more competitive, organisations are looking to using technologies as a means of enhancing the quality while cutting the costs of their processes as Universities were exhorted to do in the Dearing report in 1997.

American Universities collaborating with industry and government have adopted explicit strategies to use the potential of these collaborative environments/shared spaces to:

- Generate competitive advantage through rapid generation and dissemination of products, skills or knowledge
- Use networked communities of practice to generate, capture and disseminate new knowledge and resources
- Support training and trading functions

In Art and Design this is typified by the ID-online virtual environment developed at the University of Illinois at Urbana Champagne, which has been designed with many of these objectives in mind. http://www.art.uiuc.edu/idonline

Wider Applications

Professional working practices in an increasing range of disciplines involve information and processes which are digitally visualised/designed in shared virtual spaces where users collaborate from distributed locations. (Malins, J. et al 1999).

The collaborative design project is only one aspect of the design training and working context which could benefit particularly from a virtual environment to make use of the potential of networked technologies. Engineers, process managers, flight simulators, mathematical modellers, operations managers, medical practitioners etc are increasingly required to work as virtual team members, via a shared graphical interface as for example in the shared workspace for business teams. (See: http://www.teamsense.com)

The need to maintain or enhance quality while cutting costs in an increasingly competitive market has forced organisations to re-engineer core processes, use networked technologies where this can enhance cost-effectiveness, and benchmark best practice from other contexts. (Senge, 1994; Prusak, L. 1997).

Virtual Learning Environments as an Individual and Organisational Resource

VLEs, where they meet the real needs of users, have the potential to add value in a number of ways, which are particularly relevant to current training contexts, and to many professional contexts. The most progressive of these combine the potential of databases with web-based tools accessible to a distributed community.

These can support teaching, learning, assessment and administration processes through:

- Re-usable resource generation
- Integration and sharing of different processes on one interface
- Transparency and accountability
- Collaboration in knowledge building, benchmarking and alliancing
- Sharing resources and best practice
- Widening of access and market opportunities
- Continuous updating of organisational and professional skills and knowledge

American Universities and corporate training organisations have arguably been faster than the UK Higher Education sector to identify strategies for leveraging networked technology as part of a coherent strategy to add value, cut costs or achieve professional or organisational competitiveness. (Prusak, L. 1997).

1.2   PROJECT AIMS AND OBJECTIVES

The current SHEFC funded CAL initiative evaluates the iterative development and implementation of a virtual learning environment, 'studiospace' http://www.studio-space.net in Gray's School of Art, in the Faculty of Design at the Robert Gordon University.

The key objectives, including an additional objective, which emerged as the project progressed, are given below, and can be subsumed under the overall aim of evaluating the potential for integrating the 'studiospace' Virtual Learning Environment into undergraduate and postgraduate provision in the visual disciplines.

The Project Objectives

Objective 1

Evaluate the potential for integrating the VLE into the teaching and learning context of the organisation.

Objective 2

Evaluate the potential for using the VLE to reduce the staff unit of resource in areas through re-usable resources and integration of pedagogical and administrative processes.

Objective 3

Evaluate the potential of the system for supporting collaborative distance learning with other Art and Design institutions - Scottish, UK or global.

Objective 4 (Additional)

Evaluate the potential of such a system to enhance Professional and Organisational Competitiveness through appropriate use of a virtual learning environment via:

• Generation and two-way dissemination of current knowledge, skills and resources to wider academic and professional design community (Knowledge-building community)

• Integration, transparency, and audit of organisational/administrative processes (Quality Assurance)

• Generation and delivery of courses and resources to off-campus users via the web (CPD market)
• Potential for educational/professional/organisational collaboration via shared, web-based interfaces designed around the needs of diverse users/stakeholders

Project outcomes and deliverables

- Virtual Learning Environment (version 3) further developed and modified around the educational and organisational needs of the Faculty of Design
- Formative internal evaluation of the VLE
- Formative and external evaluation of the VLE
- Literature review
- Comparative review of VLEs
- Educational, organisational and technical criteria for development of VLEs for contexts which are:
  - Collaborative
  - Constructivist
  - Visual
- Review of strategies for adding value to networked communities through virtual environments
- Conference and journal presentations
- Prototype for Faculty Intranet capable of being implemented in Spring, 2001 for both delivery and administration of courses and other collaborative processes and activities

The audience for the project outcomes

- SHEFC
- Design Faculty at The Robert Gordon University
- Design Community
  - National
  - International
  - Academic
  - Professional
- ODL Community

1.3   PROPOSED OUTCOMES

The project aimed to further develop and implement an integrated set of software tools based on related databases accessed through web-browsers capable of Intranet, Internet and Extranet access, providing a set of cognitive tools integrated into a web-based interface to support the teaching and learning processes and contexts needed in Art and Design. These include Communication, Administration, and Authoring tools. *See figure one, page 17.*
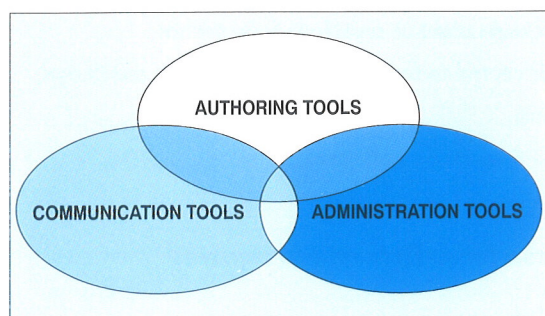
Figure one *Three integrated sets of tools*

1.4   PREVIOUS RESEARCH AND DEVELOPMENT IN THE FACULTY OF DESIGN

Art and Design is an inherently collaborative process. Art and Design training is both collaborative and competitive. At a time when the unit for staff resource for Art and Design is being reduced, the need to provide adequate professional development in the use of multimedia packages and technical processes currently requires intensive tuition that is both time-consuming and repetitive. Providing adequate training to all students, in a context of rapid evolution in the digital software packages used is essential to professional competence, yet increasingly expensive to provide.

Two previous projects in Gray's School (Faculty of Design), focused on the use of networked technologies to meet the teaching and learning needs of the Art and Design community in higher education. The 'studiospace' virtual learning environment builds on this foundation, using the potential of virtual environments to support both collaboration and the sharing of re-usable resources via web-based tools, served by a set of relational databases.

Project 1 : Reviewing Teaching and Learning in Art and Design - Development of a CAL package to support the Design Project. Leonard Smith, Richard Dyce, Ian Cargill.

The conclusions, and the software from this first Strategic Change Grant project, provided the foundation for the current project. It reviewed teaching and learning methods in design and developed a CAL package to support the design project context - a key teaching vehicle - as well as other methodologies identified as typical in their review of teaching and learning approaches in the Faculty of Design.

The design project is an extensively used teaching medium, which is typified by heavy use of resources, and dependence on one-to-one guidance. Much of the staff input relates to the exponential demand for support with use of new digital media and craft technology - rather than the intellectual and creative engagement with the task. It therefore provided an ideal focus for use of CAL to free staff resources with re-usable resources available on-line for independent learning.

This prior project identified a number of ways in which CAL packages could be creatively extended to:

- Develop and support the less tangible higher cognitive skills central to teaching and learning in Art and Design, particularly in relation to collaborative, constructive learning.
- Generate re-usable, inter-operable resources to reduce the pressure on staff time.

Project 2 : A Web-based Research Masters Course for Artists and Designers.

The Research Masters course was developed by the Centre for Research in Art and Design http://www.rgu.ac.uk/criad and delivered via a specifically designed course website http://www.rgu.ac.uk/mres

The MRes course provided a focus for researching, implementing and trialling the integration of pedagogical strategies with networked technologies in ways which could support:

- Collaborative, constructive and media-enhanced teaching and learning in a professional Art and Design community
- The use of visual methods in research and learning that use the potential of media technologies
- Papers and examples such as (Gray et al, 1996), 'Developing a Research procedures programme for Artists and Designers', Centre for Research in Art & Design (CRiAD), The Robert Gordon University are available on http://www.rgu.ac.uk/criad

This highlighted the need for a dedicated learning environment specifically for collaborative visual disciplines that require shared multimedia spaces. (Soloway, E. et al 1993).

The project also provided a theoretical, practical and technical context for identifying good practice in the application of networked technology for Art and Design, and examples of the application of networked technologies to specific aspects that were regarded as crucial. These included collaborative tools for designers to visualise, conceptualise, create, design, develop research or reflect or critically evaluate in different media contexts.

An extensive database was established providing both resources and exemplars of web-based approaches in collaborative or visual disciplines from Art and Design through to engineering and business. This focused attention on learning environments in the UK, USA, Australia and Finland in particular, where there was an early adoption of web-based learning, and an innovative design community using networked media to foster collaboration across educational and business contexts.

This gives some background to the development of the 'studiospace' virtual learning environment in response to needs identified in the Faculty, to existing projects, and to the availability of prototype tools and frameworks. These are reviewed later in this report.

1.5   VLE REQUIREMENTS FOR THE FACULTY OF DESIGN

The Technical, Educational and Organisational requirements are tabulated and discussed in detail in Section 2 (Reviewing the use of Virtual Learning Environments in Networked Communities). Much of the groundwork for identifying these resulted from the previous projects which reviewed the specific needs of the Faculty of Design for computer-based and web-based learning.

19

IN THIS SECTION:

studiospace

2   Reviewing the use of Virtual Learning Environments in Networked Communities

Virtual learning communities offer a new way to integrate work and learning. They strive to provide active learning linked to real-world experiences in which the learning can be defined as the activity through which new collective knowledge is created by its members

Davies et al, (2000)

2.1   CODEX MEMEX GENEX: EVOLVING GENERATIONS OF VLES

Competitive educational and professional markets require high levels of quality and constant updating of professional fitness as the shelf life of knowledge and skills decreases. This is set against a shrinking unit of staff: resource. Organisations increasingly depend on the leveraging of both the human and the technological resources in new ways to meet these challenges, (Prusak, L. 1997).

The review that follows looks at a range of VLEs that are:

- Designed around different professional and organisational processes
- Underpin different assumptions about both teaching and learning
- Underpin different assumptions about virtual collaboration.
- Use different metaphors

It is based on a categorisation of virtual environments in terms of the approach to learning in networked communities of professional practice.

One of the most compelling overviews of the way in which these learning environments are developing was given by Professor Ben Schneiderman, (recently retired Professor and Director of the Human Computer Interface laboratory (HCIL) in the University of Maryland http://www.cs.umd.edu/projects/hcil) at the CHI98 Conference. (Shneiderman, B. 1998). The paper, entitled 'Codex-Memex-Genex: The Pursuit of Transformational Technologies', identifies a range of ways in which networked technologies can be used to enhance the quality and effectiveness of collaborative processes in contexts where a technical infra-structure is already in place.

A review of a wide range of different environments lents available elsewhere suggests three 'generations' of VLEs, from passive transmission through to active collaboration and latterly reflective development.

Each 'generation' of networked environments is premised implicitly on different pedagogical and organisational assumptions. *See figure two.*
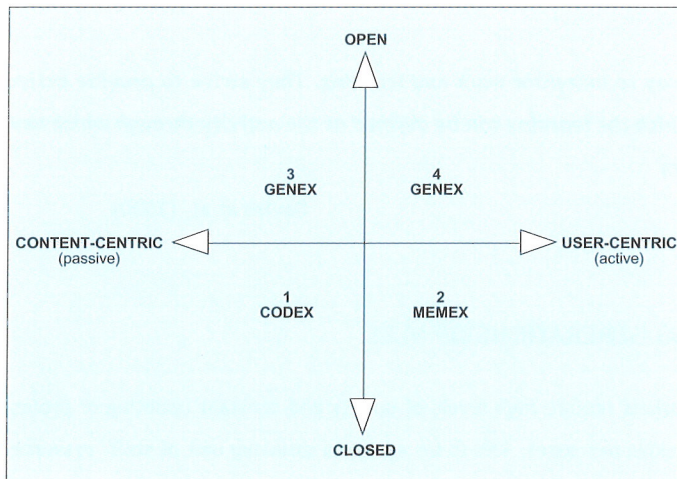
Figure two Codex, Memex, Genex: Evolving Generations of VLEs

2.2   GENERATION 1: INFORMATION SHARING ENVIRONMENTS (QUADRANT 1)

The initial emphasis in networked environments was the passive information-sharing element of information and communication technologies (ICTs), sometimes referred to as the 'banking' metaphor. In this context knowledge was a 'given' which was transmitted from expert to novice, using the network simply as a vehicle for wider or more flexible access. Subject 'gateways' and 'portals' are the most familiar examples of these systems, providing access to users to a range of information and resources in different databases.

Arguably, many systems claiming to be 'knowledge-management systems' are on closer analysis merely 'information management' systems that do not offer users the opportunity to select, organise, structure or apply the information in specific ways that can add value for the individual, the networked community or the organisation that uses it.

2.3   GENERATION 2: COMMUNICATIVE AND COLLABORATIVE ENVIRONMENTS (QUADRANTS 2, 3)

The second generation emphasises the potential of information and communication technologies to support communication and collaboration. It has moved towards a constructivist and collaborative and community-based approach supporting remote collaboration and resource sharing within distributed professional and commercial communities. A good overview of this approach is outlined by Grabinger and Dunlap, 1995. Milligan, (1999) has written two useful reviews of VLEs, http://www.jtap.ac.uk/reports/htm reviewing non-commercial environments developed in UK insititutions such as:

- COSE   http://web.staffs.ac.uk/COSE
- Co-Mentor   http://comentor.hud.ac.uk
- Learning Landscapes http://toomol.bangor.ac.uk
- MERLIN   http://www.hull.ac.uk/merlin
- PIONEER   http://www.scet.com

He includes some of the commoner commercial systems widely adopted in UK universities such as:

- WebCT   http://www.webct.com
- TopClass   http://www.wbtsystems.com

All of these provide some elements of collaboration and networked community. This is a field which is evolving rapidly in the ways in which specific user interfaces and 'cognitive tools' can enhance it.

Recent environments combine a knowledge-base with customised user interfaces - allowing them to interact to construct/create new knowledge, processes or practices that can provide competitive advantage.

The 'knowledge advantage' and the 'professional updating' and 'lifelong learning' potential ascribed to company Intranets has supported massive investment in these areas. (Prusak, L. 1997).

It is in this context that the nature (and value) of collaboration itself has become the focus of closer scrutiny.

Quadrant 2- Passive Cooperation

Some of these environments are built on a more passive model of collaboration as the cooperative sharing of information and resources using the technology as a means of:

- Making this more accessible and transparent (e.g. using the technology for dissemination, auditing, quality assurance etc.)
- Structuring of information and resources around users' needs e.g. using the technology to target or individualise information and resource access, development of 'intelligent agents' or search engines
- Providing interfaces for 'posting' information or resources to a database.

In more sophisticated developments, these may add value to distributed systems within or across organisations as Managed Learning Environments (MLEs) to integrate the management of processes more effectively and transparently. TheCoMantle project, http://toomol.bangor.ac.uk/comantle at Bangor University, for example, builds on the systems

approach used in business organisations to achieve this in an educational context.

While affording a basis for rational management that can combine the power of linked databases to centralise information and afford individualised access and management tools, this remains an information sharing and dissemination tool. Few VLEs, MLEs or shared applications build on the added value stemming from using technology to support the networked community in actively innovating, capturing and sharing new resources as competitive business now try to do. (Nonaka, 2001).

Quadrant 3 - Active Collaboration

The more recent models reflect the active construction of meaning by social interaction, as described in the introduction to this section. This constructivist approach assumes that knowledge is created and recreated through dialogue and shared experience. In this type of environment the exchange, mapping, modification and creative extension of this is an 'emergent' process requiring peer to peer cooperation and dialogue in shared spaces and a range of modalities.

These environments are more closely associated with active learning rather than the passive 'empty vessel' model. Reviews of these approaches sometimes refer to Pask's conversation theory and Vygotsky's model of 'assisted learning', (1980), in addition to constructivist theory.

Arguably the innovations in the use of technology to support these 'soft processes', (knowledge-building, knowledge representation and knowledge management), have been most rapidly developed in commercial and military contexts where the value of effective virtual collaboration impacts directly on the speed and effectiveness of organisational performance.

2.4 GENERATION 3: GENERATIVE ENVIRONMENTS FOR 'KNOWLEDGE-BUILDING' COMMUNITIES (QUADRANT 4)

Adding value to and through a networked community of practice - the 'generative paradigm' - construction, capture and re-use of transferable knowledge and resources.

The system both generates and captures knowledge assets within networked communities whether 'communities of practice', company intranets or project teams, in addition to the function of dissemination.

- HCI design customised to specific needs and collaborative contexts of professional community of users
- Collaborative spaces (textual and visual/synchronous and asynchronous) that facilitate the rapid generation of new concepts or applications from shared practice or experience
- Systems/tools to capture/share both the processes and the products of creative activity

- Systems/tools which can achieve this is with a range of visual media, and without specialist training for the web-based end user
- Scalability and inter-operability to adapt to new technologies and increases in scale of use

A growing number of networked communities depend on the use of shared graphical interfaces for their collaboration (design, product design, CAD design, construction engineering, architecture, knowledge management, supply chain management, process management, oil and gas).

This approach goes beyond providing shared spaces for the ' knowledge building community'. It harnesses the power of networked technology to:

25

- Individualise access to knowledge and resources around user's needs (i.e. it is user-centric not content-centric)
- Allow the immediate capture, authoring and re-use of new knowledge and resources via the user's desktop. (Web-based templates linked to relational databases)
- Provide virtual scaffolding for organisational processes (enhancing access, transparency, currency)
- Provide scaffolding for 'soft' processes such as quality assurance, innovation etc

These environments now fulfil a range of educational and organisational functions across distributed sites and are moving increasingly closer to an 'educational supply chain' model supporting stake-holding institutions in partnership.

As these systems have evolved it has become apparent that much of what is shared is not easily accessed or coded. It is in essence tacit. Where tacit knowledge is an important asset of organisations, as design expertise, or as non-verbal knowledge for example, the role of qualitative research and the role of multi-modal representation (e.g. visualisation) of that knowledge on shared applications has become a field in itself. Authors such as Tufte, (1990), working on the visualisation of information now have a far wider application than the field of design.

2.5   THE VISUAL DIMENSION IN KNOWLEDGE-BUILDING COMMUNITIES

Beardon (1997) reviewed strategies for the effective use of ICTs in art and design in a number of institutions in the UK and emphasised the need for a strategy that was geared to the processes used by designers. These are processes that are primarily visual, as well as collaborative, practice-based, studio or workshop based, iterative, and creative.

The studiospace environment was developed explicitly for those in collaborative visual contexts, using shared virtual spaces to create, share and re-use resources in different media.

It also aims to continue developing tools to:

- Support collaborative, constructivist approaches to learning, both for individuals and for the wider community
- Support or enhance familiar processes used by professional artists and designers
- Support constant professional updating as digital media evolves
- Provide a generative learning environment for the design community

Virtual Teams and Virtual Design Studios

Designers require spaces, tools, and processes that provide scaffolding for the visually mediated collaboration that is essential for the conceptualisation, visualisation, construction, evaluation and production of artefacts. It is a requirement that is increasingly generic to networked professions where collaborative representation, creation, management or production of information is required for a distributed community.

Art and Design practice is characterised by rapidly changing skill sets for digital technologies and an increasing demand from employers for design professionals capable of working in virtual teams, on shared graphical interfaces, with professionals from other disciplines (Jerrard, B. et al 1999). The development of joint courses for engineers, and designers, (University of Illinois at Urbana Champagne for example), reflect the expanding demand for multi-skilled professionals able to work as part of a team, across shared graphical interfaces, on the visualisation and production of products and processes.

2.6   ROLE OF VISUAL METAPHORS TO SUPPORT MEANING MAKING

We never read without some visual images or kinaesthetic modelling, we don't use mathematics or diagrams without language intervening. Writing is always a visual meaning system as well as a linguistic one.

If nothing else, computer media will spawn new hybrid genres (e.g. hypertexts, interactive media, 3-dimensional scientific visualizations, dynamic simulations) that will require the development of still more multi-literacies

Lemke, 1996

Virtual environments are increasingly visually mediated ones, and the various disciplines that relate to the visualisation and conceptualisation of knowledge are increasingly invoked in systems that support collaborative learning in shared graphical interfaces. The importance of the visual interface and visual metaphor in the 'meaning-making' process is most easily demonstrated in the context of simulation, as in car-racing simulations for example, where the speed and accuracy of information processing is crucial.

The importance of designing learning environments that are visually and functionally meaningful to learners is a key challenge for effectiveness of VLEs.

Shneiderman, (1998), for example, has developed natural 'visual' metaphors such as 'zoomable' maps and 'zoomable' user interfaces, (ZUIs), to structure vast quantities of disparate information in 'meaningful' ways for networked users that have extended the understanding of, and scope of generative learning environments.

The whole area of visual literacy is one which has been seriously addressed as organisations migrate into virtual, and therefore visually mediated transactions.

It is telling that much of the most recent research on the 'social' construction of knowledge and the use of technology to 'capture' this has come from engineering and business contexts where organisational processes are virtually, and therefore visually mediated. The new discipline of socio-technical systems build on the application of visual, social and semiotic systems of meaning-making and meaning-representation (Alderson, J. et al 1998; Lloyd, A. et al 2000).

The range of theoretical and practical applications of this are one of the most rapidly expanding areas for research in networked teaching and learning, and require multi-disciplinary methods. *(See http://www.rgu.ac.uk/criad)*.

2.7   KNOWLEDGE-BUILDING COMMUNITIES

For professional or commercial organisations at a time of unprecedented change and competition, networked learning across distributed communities offers a medium for rapid evolution and change.

For many people, the Internet is about information. Applications of the Internet as a learning environment ….often focus on information delivery .. or information retrieval. While these applications are necessary and useful, they do not make use of the medium's full potential.

I prefer instead to see the Internet as a place for collaborative learning, especially learning through working on personally meaningful projects. The key to making such constructionist learning possible on the Internet is community support. Online communities can provide a supportive context that makes new kinds of learning experiences possible. Computer network technology supports the formation of that culture.

Designers of online environments can help facilitate this process by including affordances for community support for learning.

Bruckman, (1998)

Among the many environments which use collaboration in a community context, those for children most acutely demonstrate the potential to enhance and support learning in such contexts, where the designer of the VLE has explicitly sought to provide interfaces, 'shared space' and feedback loops to do so.

Amy Bruckman's (1998) article on the use of the MOOSE interactive environments to teach children programming is an eloquent testament, in the participant's own words, to the potential of such systems to support learning through community support where this is explicitly designed in. Arguably, however, many environments which claim collaborative potential for networked communities are designed around content rather than around users needs and interests.

Some examples of collaborative or visually mediated environments are briefly described here, in addition to those perhaps more familiar from earlier reviews such as Milligan, (1999), which can be found on the JTAP site at http://www.jtap.ac.uk/reports

ID-Online http://www.art.uiuc.edu/idonline/tutorials/index.htm

The ID-Online environment (http://www.art.uiuc.edu/idonline) networks designers, academics, managers and engineers in the University of Illinois at Urbana Champagne and Georgia Institute of Technology. (See Budd, J. et al 1999).

This system performs multiple functions within a 'situated' environment.

- Training platform for a distributed academic and professional community
- Shop-window for product designs
- Knowledgebase for the community
- Forum in different media for developing new design and product concepts that benefits from the shared knowledge and resources of the wider professional and academic community

KUOMA - Learning Environment

The KUOMA - learning environment is another Internet accessible environment for project learning. http://matriisi.ee.tut.fi/kamu/kuoma
This environment was developed by Teemu Leinonen, who now develops the Future Learning Environment (FLE2) at the Univ. of Art and Design, (UIAH). http://www.mlab.uiah.fi/fle

An extract from project publications on the site gives a good sense of how a collaborative ' situated' environment can be used to support teaching and learning, and in many ways the concepts are similar to those used in studiospace.

The metaphor for the learning environment is a school building, which contains four spaces. It is typical of a range of environments using school or house or studio metaphors. (The following description is extracted from the web-site).

- The Media Centre This includes basic learning materials for students to set their own project questions. The material of the Media Centre may be multimedia material and can be composed of texts, pictures, audio and videos. To

deliver audio and video material the KUOMA - learning environment uses the TeleCom, Finland's MediaNet product. From the Media Centre the students may also browse selected resources and databases available elsewhere on the Web.

• **The Studio** This is the students' room for teamwork and for communicating with each other, and with the teachers and with individuals outside the school community. The students may discuss with and ask questions of specialists outside the school community in the www-based news-groups or in a text-based chat in real-time. The applications are used to prepare artefacts of the study subject. In the Studio the students are able to create mind maps and www-pages of their study projects. All the applications of the studio are used as cognitive tools.

• **The Meeting Room** This is the teachers' and specialists' own space to communicate and to produce new learning materials to the Media Centre. The Meeting Room includes the same communication tools as the Studio: www-based news groups and text-based real-time chat. In the Meeting Room the teachers and the specialists outside the school community may also use shared workspace, which allows storage and retrieval of documents and sharing information within a group.

• **The Gallery** This is a space where the final presentations of the students' artefacts are located. The Gallery may also contain a top ten list of the best study works of all time or allow visitors to vote for the best work.

The Conceptual Design Space (CDS)

This is a real-time, interactive virtual environment which attempts to address the issue of immersive design. This moves the concept of an environment into something more akin to a real-time social space. It is one of a number of environments developed in collaboration with the Graphics, Visualization, & Usability Centre in the Georgia Institute of Technology and is outlined by Bowman, (1996), in 'Designing Digital Space'. Graduate students from Georgia Tech's College of Architecture used CDS to create conceptual building designs, and create or change them while immersed in the virtual world.

The Media MOO Environment

This environment builds specifically on the concept of constructivism in a community context in design research. Amy Bruckman and Mitchel Resnick, (1995), describe another "immersive" VLE project which is a text-based, networked, virtual reality environment designed to enhance professional community among media researchers. The environment is continuously constructed and reconstructed by its members and is intended to reflect constructivist principles in virtual reality design.

The philosophy of constructivism argues that people learn with particular effectiveness when they are engaged in constructing personally meaningful projects; learning by doing is better than learning by being told. They argue that that letting the users build a virtual world rather than merely interact with a pre-designed world gives them an oppor-

tunity for self-expression, encourages diversity, and leads to a meaningful engagement of participants and enhanced sense of community.

Exploratory or Transformational Networked Communities

Nolan (1995), further develops the concept to include transforming the learning environment itself. The MOOkti environment uses the concept of transformational learning where the community can redesign the environment itself - the ultimate in 'moving the goalposts'.

As in action research, it embraces the concept of development and change as a direct result of the exploration, action and reflection of the community itself. This is an emerging area, which, together with the growing potential for role playing, and tools for acting on and in 'immersive environments' offers scope for types of interaction that are not possible in real life.

Generative Virtual Learning Environments

The studiospace system (http://www.studio-space.net) is designed as a generative environment. The Asynchronous Learning Network magazine (ALN Magazine, Volume 1, March 1997) provides a definition of this emerging concept as an extension of constructivism.

Generative environments are held to use a variety of tools to support co-operative learning, and the development of higher cognitive skills, including:

- Socratic dialogue
- Exploration of multiple perspectives
- Development of prior individual or captured group knowledge
- Brain-storming
- Categorisation
- Adaptive approaches
- Real-world problem-solving
- Construction of mental models
- Shared visualisation and graphical representation

The list has clear implications for use of networked technologies (e.g. relational databases, web-accessed graphical interfaces and customisable, individualised displays for end-users). The studiospace VLE makes optimal use of the potential of networked technologies to support the development of higher order skills through shared visualisation of, and collaboration on authentic design problems and processes in this way.

In addition to this, studiospace provides an engine for the capture, representation and re-use of what is generated by the community, in a range of media, and in ways which are accessible to any user with internet access, without the need for technical expertise in authoring. (Web-templates for access to a knowledge-base).

The currency and quality of the community's resources are thus enhanced by and for the group, and potential costs of resource development and course development are considerably reduced.

In the context of collaboration with partners in joint projects, this adds value to the potential of the organisation and the community in terms of what can be both brought to a joint initiative, and what can be gained from it.

2.8   CHOOSING A LEARNING ENVIRONMENT

The 'best' system is a function of the match to the needs and purposes of users, rather than a property of the system itself.

(Laurillard, D. 1993)

Davies et al (1998) explore three on-line learning systems in a fair amount of depth through actual delivery in The University of Toronto, and comment on the different 'metaphors' implicit in each approach.

The Virtual university, WebCSILE (now Knowledge Forum) and MOOkti environments are all 'constructive' environments, taking a constructivist's approach to learning, however the different 'metaphors' they use reflect the different purposes of the communities for which they were designed. This has implications for their applicability to different contexts.

This is clearly a relevant factor in choosing the 'best' system, but it would seem to suggest the importance of further exploring a process analysis approach here, as already happens in industry where key functions of the organisation are mapped onto the Intranet.

The Virtual University (VU)

The metaphor for the VU is 'the campus'. The system reflects the administrative processes of course organisation, with an interface that imitates the University campus and its functions visually. *(See: http://virtual-u.cs.sfu.ca/vuweb)* at Simon Fraser University in Burnaby, British Columbia.

CSILE

The CSILE (Computer Supported International Learning Environment) is a knowledge-building community environment hosted in Ontario Institute for studies in education.

This environment emphasises information and communication tools, as opposed to the emphasis on cognitive tools in CSILE.

The metaphor for Computer Supported Intentional Learning Environment CSILE (Now Knowledge Forum) is that of the 'expert community' where knowledge is perceived to be actively constructed by and for the scientific community. http://csile.oise.utoronto.ca

This is a prevalent metaphor in both educational and business contexts, and is in keeping with a constructivist approach to learning. This increasingly prevalent approach maps well onto the potential of networked media for supporting collaboration over a distributed virtual network as the basis for adding value to and through the community. (Bruckmanand & Resnick, 1995).

The MOOkti Environment; University of Toronto

This environment emphasises all these activities but goes further and includes the extra dimension of interacting with the VLE itself. This potential to alter the shape of the virtual environment, as some immersive environments do is sometimes described as 'transformational' learning (Nolan et al 1998).

There is a spectrum then of use, from the mere use of the internet to recreate existing processes on-line, to the exploitation of the extra potential of the net to allow new or enhanced community processes that would not be possible within a traditional learning environment.

2.9 CONSTRUCTIVIST APPROACHES TO ONLINE COMMUNITIES AND LEARNING ENVIRONMENTS

A criteria for the design of studiospace was that it supports collaborative, constructivist approaches to learning in different media. Most of the examples given in the report exemplify this in one way or another.

A good overview of the use of the constructivist paradigm for web-based learning contexts is given by McMahon (1997). He outlines the development from early Piagetian processes of accommodation, assimilation and equilibrium, to the more current adaptation of this as 'social constructivism' pioneered by Vygotsky (1978) as a social construct mediated by language via social discourse.

Laurillard (1993), in a text that has become a standard in this area, emphasised the iterative, interactive and dialogic nature of these constructivist approaches, and the implications for embedding new technology effectively into education in a university context.

Jonassen, (1994), has also written extensively on the application of social constructivism to the use of educational, and particularly, web-based tools for supporting meaningful learning. The 'Manifesto for a Constructivist Approach To Technology in HE' , (Jonassen, Mayes and McAleese, 1999), also outlines underlying principles. http://www.icbl.hw.ac.uk/ctl/mayes/paper11.html

One of the best 'one-stop-shops' for exploring this is maintained by Martin Ryder at the School of Education in the University of Colorado at Denver, one of a number of resources available on http://csile.oise.utoronto.ca/CSILE_biblio.html. Given the number of well-established initiatives in America, Canada, Australia and Finland - in both development, implementation and evaluation of effectiveness - it would seem useful to build on the external experience of early adopters.

2.10 COMPARING VLES

A range of sites and reports have provided reviews of Virtual Learning Environments, which have been overtaken by the speed with which these networks have developed.

Given the importance of identifying users' needs as a pre-requisite for choice, identifying systems that match these can be confusing, as many sites give limited information and often home sites require a password for access.

The Landonline resource, from the University of British Columbia in Canada, provides the most comprehensive list of commercially available environments, with the most exhaustive details of functionality, which are regularly updated, and to which live links are available. http://www.ctt.bc.ca/landonline/choices.html
A further useful site with extensive reviews, comparisons, test drives and evaluations for both VLEs and shared applications and web tools is http://www.osc.edu/webed/tools.htm

Within the UK, smaller lists are available of commonly used environments in the UK higher education sector, some of which are free to institutions, having been developed as part of funded projects. Non-commercial systems such as the COSE environment, for example, will be found here. This site, for example, provides a comparison of VLEs typical of the UK context http://www.longman.net/COSE/comparison/index.html
The JISC website also offers range of reports http://www.jisc.ac.uk
The further education sector also provides extensive resources for colleges seeking to choose or use VLEs, and has included a survey of managed learning environments (MLEs) in http://ferl.becta.org.uk/features/mle

2.11 MATCHING A VLE TO USERS' NEEDS

If the design begins with an analysis of the specifics of students' learning needs, then it is more likely to achieve genuine learning gains

Laurillard, D., Manning, P., (1993)

A recent review of the needs of staff developers supporting the use of educational technology in Scottish HEI's identified VLEs as a major area of concern in relation to both choice and implementation. http://netculture.scotcit.ac.uk In America and Australia this demand is already well documented. (McNaught, 2001).

VLEs are generally compared in relation to the tools they provide, rather than in relation to the educational and organisational needs they can best meet.

The studiospace environment was designed around a range of identified pedagogical and organisational needs, and VLEs in the report are categorised on this basis.

Arguably, the effectiveness of any learning and teaching approach to learning technology depends on selection and use that best meets the needs of learners and training providers. (Nunan).

A number of writers and researchers re-iterate this in the case of approaches which are technologically mediated, as in the case of VLEs. (McGreal, R. 1998). A key, but under-estimated dimension to this, is the need for adequate and updated assessments of the changing needs of learners in very different working environments.

There is a growing move towards the integration of systems that provide feedback on needs and progression of individuals, groups and organisation via profiling, auditing and other systems that have the potential to provide such a 'feedback loop'. Talent Project, http://www.le.ac.uk/TALENT

In identifying existing systems and tools that had the potential to meet users needs in the context of Art and Design, a range of tools that related to identified needs were mapped onto a matrix as in Table One *(See page 35)*.

MATRIX EXTRACT (TABLE 1)

VLE	ID-Online	Studio-space	Lotus Learning Space
Company	University of Illinois at Urbana-Champagene; Georgia Institute of Technology	The Robert Gordon University (Gray's School of Art)	Lotus Devl. Corp.
Web Site	http://www.art.uiuc.edu/idonline	http://www.studio-space.net	http://198.114.68.60
Designed for Art & Design course provision and support			
Course specific contexts (Gallery, Studio etc.)	●	●	Can be customised
Integration of TLA around tutor/student needs.	●	●	Can be customised
Course management		●	
Internet/Intranet access	●	●	●
No training required	●	●	
Communication Tools (Text)			
Email	●	●	●
Threaded discussions	●	●	●
Web-based conferencing	●	●	●
Attach text & images	●	●	●
Communication Tools (Visual Media)			
Graphic display tools	●	●	●
Shared multimedia documents	●	●	●
Shared video clips		●	
Slide-show presenter			●
Multimedia lecture hall		●	
Collaborative Tools (Text)			
Document sharing	●	●	●
Collaborative concept mapping		●	●
Document annotation	●	●	●
Collaborative Tools (Visual Media)			
Image sharing	●	●	●
Collaborative mapping of text and multimedia	●	●	●
Collaborative design facility	●	●	●
Generative Tools (Text)			
Authoring tool for reusable resources	●	●	●
Knowledgebase for sharing individual resources and generating organisational benefit	●	●	●
Generative Tools (Multiple Media)			
Authoring tools for creating re-usable multimedia resources		●	●
Knowledgebase for sharing resources	●	●	●
Multimedia lecture tool (video clip, sound, text and image)		●	●

IN THIS SECTION:

studiospace

3   Studiospace: Building a VLE around Educational and Organisational Needs in Art and Design

There is no 'right' answer. There are simply better or poorer choices based on how well tools are selected to match both organisational and technical requirements'

McGreal, R. (1998)

37

3.1   DEVELOPING A VLE AROUND USERS' NEEDS

Selecting or developing a virtual learning environment and the associated tools requires both generic and specific criteria as a basis for choice - from educational needs to organisational, technical and cost-based factors, as previously indicated.

Cost-effectiveness? Quality Assurance? Good Practice?

Cost-effectiveness in both training and educational contexts is increasingly premised on the match to users' needs (Laurillard, D. 1998; Bates, T. 1999), and the choice of the 'best' solution is relative to the educational, organisational and administrative needs and objectives of a wide range of stakeholders in the educational process. (Beerel)

These stakeholders are staff and students in the first instance, but must include the needs and objectives of the institution, and the educational, economic and social framework which shapes and supports it.

What About Proprietary Solutions?

Most virtual learning environments are commercial and meet generic, assumed needs which vary in their applicability to different disciplines. A review of existing systems and the findings of the previous SHEFC study identifying a gapin key areas in the provision for collaborative visual disciplines led to the conclusion that a proprietary solution was not going to be suitable for this project.

Collaborative visual disciplines such as art, design and product development benefit from an environment and cognitive 'tools' that emphasise the collaborative, visual nature of their practice, and from customisation of interfaces to reflect their working contexts (studio, lab etc). Commercial packages in the future may move towards generic tool sets, with configurable and customisable interfaces. Studiospace is designed around the technical, educational, and organisational needs/requirements identified in the next section.

EDUCATIONAL REQUIREMENTS (TABLE 2a)

Support Virtual Community of users on and off campus with access to:

Tutor

Peer group

Learning resources

Shared interfaces and spaces

Collaborative tools

Authoring tools

Support Teaching & Learning methods that are:

Collaborative

Constructivist

Practice-centered

Visual

User-centered

Enjoyable

Support range of learning styles/contexts

Peer, tutor or computer-assisted learning

Class, work or home-based learning

Lifelong learning

Reflective learning

Assisted learning (students with disabilities)

Provide cognitive tools

Tools that support teaching, learning & assessment in shared virtual spaces

- collaborative learning and teaching
- collaborative design
- to support & evidence QA processes

Visual Architecture for Pedagogical Processes

Mapping the interfaces and links in the virtual teaching, learning and assessment processes

Visual maps and metaphors

Links to relevant stakeholders

Individualised interfaces

Professional Development

Tools for auditing, reflection, planning, resourcing and evidencing of development - academic, professional and organisational.

Profiling/auditing skills or knowledge

Reflection

Action planning

Resourcing

Evidencing

Recording

Organisational Development

Tools for integrating of teaching, learning and assessment around assessed learning outcomes

Provide Generative Tools

For rapid generation of relevant new resources

Rapid updating of curricular materials

Provide digital archive for design artefacts

Provide on-line 'shop window' for designers

Generate added value through interaction

With wider community of academic/professional/commercial users

Generate searchable resources for independent learning

Course development

Research through interaction with the wider networked community

TOOLS DEVELOPED TO MEET REQUIREMENTS (TABLE 2b)

Admin & Educational Support Tools

Course management tools

Resource management tools

Calendars

Interfaces

Student monitoring tools

- Identification
- Tracing
- Assessment matrix (including learning outcomes, assessment criteria and marking scheme)

Student profiling and recording tools

- Profiling
- Recording
- Review
- Action planning

Authoring and Delivery Tools

Knowledgebase (multimedia capable)

Module content database

Module descriptor database

Records database

Interfaces

Virtual lecture space tool (online lecture tool)

Communication and collaboration tools

Email (hyperlink enabled)

Synchronous/asynchronous chat facility

Shared whiteboard (in development)

Collaboration CAD/CAM (in development)

Digital archive and gallery (in development)

Shared Graphical User Interfaces (GUIs) - a wider generic application

The interest generated in commercial contexts such as engineering, product design and distance learning has already provided evidence of the demand for such environments for collaborative teams in other contexts, where visualisation of information, process management, prototyping, and product design - are no longer just the preserve of Art and Design.

The emergence of the 'virtual team' as the modus operandi of the majority of networked commercial and professional organisations has widened the scope for application of such tools to a wider, and more generic context.

3.2 BUILDING THE STUDIOSPACE VLE AROUND USERS' NEEDS (TECHNICAL, EDUCATIONAL AND ORGANISATIONAL)

The development of studiospace is based on:

- An analysis of the educational and professional needs of practitioners in visual methods, working on and off campus in a number of SHEFC and AHRB funded projects.
- A review of good practice in collaborative, visual and practice-based virtual learning environments for the web-based MRes and CAL projects for reporting by January 2001.
- Feedback from elements of the virtual learning environment used with web-based students on the MRes course.
- Feedback from the first CAL Project.

The key technical, organisational and educational criteria that informed selection and development of the components and overall environment design are listed in the accompanying tables.

Technical Requirements

The team developing this foundation project concluded that, due to the collaborative, visual and multi-media nature of design project activity, and the increasingly distributed delivery of training, any environment to enhance teaching and learning would need to combine a range of features not available off the shelf in existing systems.

- Multimedia-capable (Shockwave, Director, Quick-time Video clips).
- Cross platform for PC and Mac users.
- Accessible via the web for users on distributed campuses, at work, at home, abroad.
- Capable of generating re-usable, inter-operable, re-formattable resources.
- Authorable by non-technical users from a template (not requiring html coding etc).

The listed requirements were used as the basis for a number of system developments. *(See Tables 3, 4, &5).*

Technical and Educational Requirements

The technical and educational requirements of such a system were further clarified in the course of research, development and evaluation carried out as part of a second project to develop a web-based Research Masters course for professional artists and designers within the Faculty.

This involved the research and review of web-based environments that could be used to support the kind of collaborative and learning and teaching required for virtual teams in visual contexts. Given the current trend towards distributed working practices and shared graphical user interfaces (GUIs) in all professions this has wider application.

3.3   TECHNICAL REQUIREMENTS (TABLE 3)

Requirements:

Accessible via web browser on and off campus

Cross-platform

Web-based delivery of multimedia resources

Multimedia capable text, sound, image, video (Flash/shockwave)

Re-usable, inter-operable course/resource materials that can be authored by non-technical staff from desktop

POP3 Capable

Secure access

Easily up-dated

Built with separate components that can independently be up-dated

Human computer interface

- simple, intuitive navigation
- customisable to context
- individualised to different users needs
- re-sizeable to browser windows

File Sharing

Table 3 outlines technical criteria such as compatibility, adaptability, expandability, connectivity, accessibility, re-usability and inter-operability which also figure in a number of international projects such as the IMS, Ariadne http://ariadne.unil.ch/project/main.navigation.html and Prometheus projects http://www.prometeus.org
The human computer interface was also a criteria with both technical and educational implications. Research suggests

that simple, intuitive interfaces are important, and the potential to customise these, and 'anchor' the student in a virtual environment that reflects familiar contexts and processes (e.g. lab, studio etc.) is a factor.

3.4   ORGANISATIONAL REQUIREMENTS (TABLE 4)

Table 4 outlines the key criteria relating to teaching and learning methods, learning styles, learning contexts, teaching and learning support, assessment and professional development.

Requirements	System Developments
Knowledge Management Tools:	Knowledgebase (multimedia capable resource database)
For course and resource capture and delivery	Module content database
For non technical user in distributed sites to rapidly generate re-useable and interoperable resources from the desktop	Course module descriptor database
Tools for	Authoring tools for non-technical experts
● Capture	Authoring and delivery tools and templates such as the virtual 'lecturespace'
● Desktop authoring	Web interfaces/templates
● Dissemination	Email (hyperlink enabled)
Communication and Collaboration Tools	Synchronous/asynchronous chat facility
	Discussion forum
That generate shared, transferable resources for both providing institution and wider professional community to maintain currency	Shared whiteboard/graphical user interface (in development)
	Web interfaces/templates to anchor processes in discipline e.g. studio, lab
Tools and Multimedia 'spaces' for:	'foliospace' virtual gallery tool - to archive design work for research, review, as online 'shop-window' (in development)
Communication	Course administration and management tools (registration lists, course lists, records, tracking, time tabling etc.).
Collaboration	Assessment matrix tool (unifying range of assessment records for continuous monitoring)
Construction	
Critical review	
Demonstrating and archiving	
Management and Administrative Tools	
To support organisational processes and requirements such as:	
Transparency and accountability of teaching, learning and assessment processes (QA etc)	
Coherence, currency and consistency of information,training and resources	
Course administration and documentation - opportunities for monitoring, reviewing and supporting student or course development (QA)	
Professional development - project management	

These relate to both specific objectives, (such as shared graphical interfaces) to more general ones highlighted in the Dearing report (http://www.leeds.ac.uk/educol/ncihe/) such as innovative use of ICTs to support lifelong learning.

Networked technologies are ideally suited to support current 'constructivist' approaches to teaching and learning based

on the active generation of personal constructs from shared practice and experience, mediated by dialogue. (Resnick, M. 1995; Cunningham). These were key criteria which it was felt could be met by integration or further development of web-based tools and templates.

The table outlines others relating to the need to:

- Integrate information and processes on shared documents
- Provide transparency and accountability
- Support progression, recording, review and professional development

These reflect both the need to provide a feedback loop to staff and students, and the requirement to evidence both processes, documentation (and added value) for internal and external audit as required for Quality Assurance procedures for example. http://www.qaa.ac.uk/COPaosfinal/genprint.htm

Among the less obvious criteria is the perceived need to develop tools that support the teaching, learning and assessment of higher order skills which do not lend themselves to 'right-wrong' answers (but rather rely on the development of argument and dialogue around shared experience).

3.5   ORGANISATIONAL REENGINEERING

Organisational needs were less apparent initially, until development of educational tools raised implications for interfaces with organisational processes and requirements.

Real integration of a prototype system would eventually require a virtual unification of some of the course, resource and student and information management systems operating in a more fragmented form within the school beyond the scope of this research and evaluation project.

For 'studiospace', as a prototype VLE, criteria were restricted to those areas directly impinging on the teaching and learning function, such as course management, module management and resource management. It is evident that this could be extended to making a range of processes more transparent, effective and accountable for review (QA, Common Course Architecture, Student Progression, Course Review etc).

Although, additionally, there was a decision to build on the project and implement it as a faculty intranet, a number of issues required synchronisation and compatibility with key organisational processes across the University.

Ensuring currency of shared records is one example of such a system, yet achieving this across a large organisation with fragmented, responsibilities is an undertaking that requires time, patience, resources and a commitment to

change. The fact that this was achieved, almost incidentally to a range of other emergent requirements, is attributable to the credibility and determination of one of the project team to identify the most accurate sources, and design and implement processes to ensure this was the shared record.

One of the most valuable outcomes of developing a system like studiospace was the realisation that the planning and brainstorming process with the different users/stakeholders in the organisation would prove to be the most crucial determinant of success or failure. Such a development requires the integration of very different user requirements and initial personal perceptions of what the system is capable of and how it could be implemented. The interdependencies between social, technical and organisational systems are increasingly emerging as a problem across networked organisations, and underline the need for an ongoing dialogue between stakeholders. (Lloyd et al, 2000)

In addition to the very different conceptualisations of how a system can meet different needs, there is a lack of understanding of how a new system can meet/build upon and improve the procedures already in place on a paper based environment. Organisations which apparently run efficiently whilst working within separate departments, may find themselves in a situation where all the information from within the organisation can be held centrally - therefore anomalies which were previously hidden become apparent. Individuals who have been content working within a paper based or older system which they know has flaws, find themselves in a situation where all the problems need to be exposed.

Roles and responsibilities also change in such a system, and this may bring both benefits and concerns. Ownership of materials and information becomes less individualised as more people have access to them. Users become more dependant on one another supplying the correct information, keeping the system up to date, and using standard software. This drives a demand for clearer, more transparent and more accurate information at a quicker pace.

Staff may have an element of apprehension over the learning curve of a new system, on top of the every day work load. This requires re-assurance that the new system will be intuitive, usable and appropriate for users' needs, and that they will involved in the design and development of the new system.

The whole re-engineering process requires constant consultation not only with the departmental managers but also the general staff and users. As the system is under development, an ongoing process of discussion, and amendments to the system requires a structured time management line that everyone is involved in.

What started as a simple project with initial aims and objectives becomes an organic, fluid, ever-changing system which needs constant update, upkeep and training for staff, as well as sufficient technical assistance and backup procedures to ensure the minimum of downtime if it should crash.

3.6   OTHER CRITERIA

HCI Criteria for the Design Context

The human:computer interface (HCI) was also a criteria with both technical and educational implications. Research, (Shneiderman, 1999), suggests that interface design can help or hinder the ability of the user to process information, enhance cognition or creativity. Like a number of others he emphasises the potential to customise these and 'anchor' the student in a virtual environment that reflects familiar contexts, (e.g. lab, studio etc.) and cognitive processes (e.g.'zooming in' with the eye).

45

In a seminar paper on the use of User interfaces to support innovation, (Shneiderman, 1999), suggests a four phase framework for creativity, based on three different perspectives on creativity in the literature.

He categorises these as 'inspirationalist' such as de Bono, 'structuralist' such as Mayer (1992) and 'situationalist' such as Csikszentmihalyi, (1996) and suggests how interfaces and tools can be designed to assist this process.

He summarises a range of processes that can be supported by appropriate design of interfaces and further suggests tools that include many of the elements which studiospace attempts to provide.

Metaphors for 'situating' learning

Vygotsky, (1980) contributed greatly to the perception of learning as a collaborative, social activity where the learner constructs and reconstructs their understanding with and through others. McMahon (1997) provides a review of this constructivist perspective.

Different environments have adopted different metaphors carried through visually - the community, the house, and the office. The studiospace VLE adopts the concept of the studio as a natural 'space' for a community of artists or designers. The customised interfaces reflect the spaces and the processes that structure their working and studying context.

Usability

Design is an iterative process, and interface design particularly so. It is only through trial and error that the most 'usable' interface is achieved. As the evaluation results indicate, the focus of much of the redesign, both functional and aesthetic, was to simplify the ease of movement from interface to the preferred working area, in what was described in the prototype. This will by no means be the final iteration of this design. Changes have to be made on a continuous basis to accommodate the need to incorporate different user demands.

Re-structured Design

Form was re-designed around function, and as new or adapted functions were researched they were added to accommodate the possible needs of different groups.

A key element of the design was the use of visual metaphors and visual media, not only because this was for use in visual disciplines. As Schneiderman (1992) indicated, information processing can be greatly enhanced by the use of visual displays which build on the way vision itself operates. The 'zoomable user interface' design for example, allows huge quantities of information to be understood and processed via a small screen, in ways that text-based displays are unable to achieve.

From a learning point of view, the use of visualisation and the use of multiple media to enhance this helps users understanding and retention of complex material, (Lemke, 1996), and where this is structured effectively around learning, it can enhance the quality of the learning experience.

3.7   NEW PARADIGMS FOR COMPUTING, NEW PARADIGMS FOR THINKING

"The best computational tools do not simply offer the same content in new clothing; rather, they aim to recast areas of knowledge, suggesting fundamentally new ways of thinking about the concepts in that domain, allowing learners to explore concepts that were previously inaccessible"

Resnick, M. (1995)

VLEs are one of the ranges of new 'cognitive tools' that can support learning in new ways by exploiting the potential of networked media technologies to represent, transform or generate in different modalities.

Mitch Resnick, in the Epistemology and Learning Group of the MIT Media Lab, is one of a group who have looked particularly at the new opportunities these developments in computing provide for supporting thinking and knowledge representation.

His approach to the design of technology to support education is premised on three assumptions which are directly applicable to the design of learning environments, and under-pinned the design of the studiospace environment.

Understanding of the Learner:

What are the learner's preconceptions and expectations? How will the learner integrate new experiences into existing frameworks? In what ways can learners construct new concepts and new meanings and in what ways can new computational media provide scaffolding to support this process?

Understanding of Domain Knowledge.

If a new computational tool or activity is intended to help students learn about a particular area of mathematics or science, the designer had better know something about that area of mathematics or science. But there is a deeper point. The best computational tools do not simply offer the same content in new clothing; rather, they aim to recast areas of knowledge, suggesting fundamentally new ways of thinking about the concepts in that domain, allowing learners to explore concepts that were previously inaccessible.

9

studiospace

4   The studiospace Virtual Learning Environment

The current version of the 'studiospace' VLE is on http://www.studio-space.net, and includes a range of features designed to meet the needs identified and support the key educational and organisational processes. It includes web-based authoring, communication and administration tools linked to a knowledge-base and is being evaluated with a range of different target group as a means to:
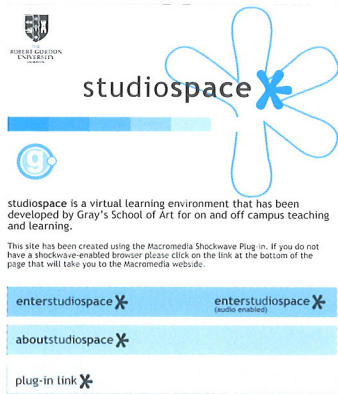
studiospace is a virtual learning environment that has been developed by Gray's School of Art for on and off campus teaching and learning.

This site has been created using the Macromedia Shockwave Plug-in. If you do not have a shockwave-enabled browser please click on the link at the bottom of the page that will take you to the Macromedia webside.

enterstudiospace ✶

enterstudiospace ✶ (audio enabled)

aboutstudiospace ✶

plug-in link ✶

Figure Three studiospace Home Page

- Add value to undergraduate and web-based teaching, learning and assessment in Art and Design
- Reduce the demand for staff: student time on tasks that can be computer-assisted
- Enhance cost-effectiveness and integration of educational/organisational processes
- Enhance transparency, flexibility and accessibility of teaching and learning
- Support generation and dissemination of re-usable, inter-operable resources

A range of web-based tools and interfaces have been developed to meet these needs, combining customisation of the user interface and user access, linked to a set of relational databases.
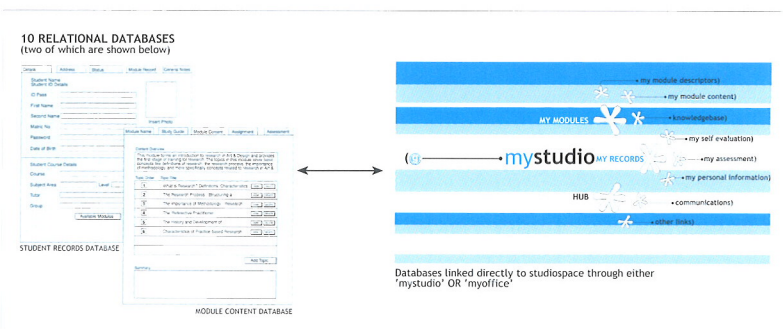

Figure Four Database links to Web Front End

4.1 AUTHORING AND DELIVERY TOOLS

Most crucially, these allow staff on distributed campuses the capacity to author course material directly from the desktop, with no technical expertise to put new course and resource materials directly into the database and have these automatically formatted for CCA compliance - or other formats.

By making this resource accessible via the web, the wider networked community has a basis for rapidly updating, sharing or generating educational currency within the professional community, as American university and business partnerships increasingly do. (NCML).

At a time where the shelf life of skills and knowledge are shrinking rapidly, the potential to generate marketable training resources for and from the wider professional community is a relevant criteria.

Module Descriptor Database

This provides a structure for storing all the module descriptors currently in use at Grays School of Art. This includes separate fields for all the learning outcomes. This information is reused for assessment and self-evaluation purposes. The module descriptor database is an essential component of the system.

Module Content Database

Course content is stored in the module content database, which is one of ten linked databases. Course content is stored here, and authoring involves 'cutting and pasting' text or visual media into appropriate fields. No technical expertise is required. The information can be used to generate assessment pro-formas and self-evaluation pro-formas that are completed on-line. Once entered into the database, the information can be seen on the web site.

Resource Database (knowledgebase)

In addition to the module content database, a searchable resources database has also been developed. The knowledgebase provides a repository for process or skill-based information that can link to specific module content or simply be browsed. Links to other web sites can also be stored in the knowledgebase.

Student Records Database

This provides a concurrent record of student progress, including a record of assessment.
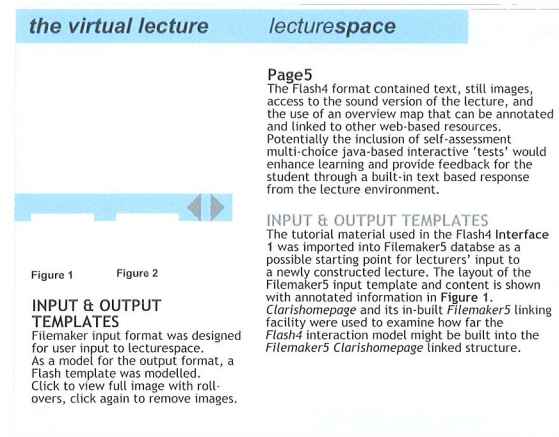
Virtual Lecture Hall (lecturespace)

Figure Five lecturespace environment

This is another prototype tool, developed as part of an AHRB-funded project http://www.rgu.ac.uk/lecturespace, which allows the construction and delivery of virtual 'lectures' in multiple media that supports visual tracking, sound, text and images in ways which have implications for supporting a particularly wide range of learning and teaching styles, and enhancing the interactivity and effectiveness of training resources.

4.2   COMMUNICATION AND COLLABORATION TOOLS

These are largely familiar and self explanatory, and are pulled together as part of the 'hub', which uses the FirstClass interface.

- Email (hyperlink enabled)
- Conferencing
- Synchronous/Asynchronous chat facility
- Discussion forum
- Calendar
- Diary
- Shared Documents (Text and Image)
- Shared Web pages

The latter extends the collaboration 'space' into more visual contexts, and has wider generic application in a range of other contexts where digital visualisation is important - from information management, product design and process management. The communications 'Hub', for example, supports:

• Text-based tasks such as those designed for peer group learning on the web-based research Masters Course for artists and designers http://www.rgu.ac.uk/mres/course, where students act as members of a virtual research degrees committee to assess each others research proposals.

• A related tool, foliospace, will provide a further visual tool to provide access to a 'gallery' or a personal 'portfolio' of work and work in progress. This can be used to:
  - Support teaching and learning by example (or inspiration)
  - Support submission/assessment for Socrates students on European placements
  - Archive methods and processes (central for product design)
  - Provide an 'on-line' shop window for student' work

4.3   TOOLS FOR MANAGING EDUCATIONAL AND ORGANISATIONAL PROCESSES

These tools are intended to help meet the need for coherence, currency and shared access to course and student related data over distributed sites on and off campus.

Managed Learning Environments (MLEs) typically include tools of this nature, though they concentrate more on the administrative rather than on the educational processes. For example:

• Course management tools
• Student tracking tools
• Assessment matrix tools
• Student profiling and action planning tools
• Skills audit matrix tool (in development)

In addition to the logistics of shared access, the degree of customisability allows information and teaching/learning resources to be customised around the needs of individual users.

Quality Assurance

This system has specific implications for the transparency of quality assurance processes, and provides a means of documenting student, staff and course development in response to feedback and support. http://www.qaa.ac.uk/COPaosfinal/genprint.htm

4.4   DEVELOPMENTAL TOOLS

Personal and Professional Development

Figure Six Student Self Evaluation/Staff Feedback Tool

53

The Professional Development profile, for example, can be used to support independent or supported learning, assessment, mentoring, recording or action planning - with the potential to link to resources to support an individual action plan or learning contract.

In effect, it provides a 'portable' document for lifelong learning that can be used to support or evidence learning in education and at work.

Organisational Development

The integration of processes on shared, web-based interfaces, has the potential to make organisational and educational processes more transparent, more tailored to need, and easier to evidence for QA purposes, course audit, course review - or simply in providing timely and focussed support for student progression.

4.5   ADDING VALUE TO NETWORKED COMMUNITIES

The concept of web-based tools, linked to a dynamic relational knowledge-base allows for the generation of re-usable, inter-operable resources for and by the professional and academic community. These reflect the growing demand for skill development in a rapidly developing field, at a time when there is a shrinking unit of staff:student resource.

54

studiospace

5 Methodology for Evaluation

The project has been evaluated in relation to users' needs on the one hand, in iterative fashion, and in relation to the original SHEFC objectives. (Please refer to point 1.2 of this report).

5.1 INTERACTIVE ACTION RESEARCH

The methodology is based on an interactive, action research cycle that moves from initial formative feedback for and by the internal stakeholders and collaborators, to more summative external feedback against specific criteria. Formative evaluation is conducted while a program, courseware, or product is under development. Its purpose is to use data gathered during development to detect errors and weaknesses, and to apply it in order to improve the product. Summative evaluation is conducted after a product has been developed and is ready for the market.

This is in three stages, with feedback, modification and re-testing at each:

- Initial feedback from small trials with a focus group - observation and qualitative feedback.
- Secondary feedback against specific criteria with a larger group - qualitative and quantitative feedback against criteria.
- External feedback with larger group where possible against specific criteria.

Scriven (1991) outlines four phases in formative evaluation:

- Alpha testing or in-house critiques by colleagues or employees not in the development group
- Hot-house, focus groups, or field trials with hand-holding (the development team supervises off-site tests)
- Hands-off field trials or beta tests at 'remote sites by supposedly typical users working on their own in their usual environment'
- The 'review preview' phase: 'full-scale commissioned evaluations by external expert reviewers... in which the reviewer may and should run systematic experiments with end-users' in the case of more commercial product testing.

Other projects have found this useful for iterative testing over distributed, networked sites, progressing from initial testing, and handholding, internally, to more summative, external testing after initial feedback and modification.

The EVNET project, http://socserve2.mcmaster.ca/srnet/evnet.htm used this approach, underpinned by the philosophy below, to evaluate the use of educational technology over a network of Canadian Universities. They underline the importance of evaluation in relation to:

a. Learning and Teaching Objectives *(extract from the EVNET Project)*

The pursuit of best teaching, learning, and training practices must tie the purpose of action-oriented research to an applied outcome. evaluation methodology is one of the best vehicles for doing so (e.g., Tyler, Gagne and Scriven, 1967; Scriven, 1993). In the relationship between researcher and partner, the value or goal of a program, product, courseware, software, or manual must be clearly specified at the outset (Winne, 1993). Two such values or outcomes are "learning effectiveness" and "efficiency". The tangible product is then 'evaluated' by its approximation to the purpose or objective of the product as stated by the client or partner.

b. Learners and Other Users' Needs *(extract from the EVNET Project)*

The user, learner, and trainee, and the partner organisations in which they are located, take centre stage in establishing the benchmarks for evaluation. In other words, evaluation of the means of education and training delivery is 'learner-driven'. We are not conducting 'ivory tower', pure or abstract research. Nor are we pursuing 'knowledge for knowledge's sake'. We are seeking knowledge for the applied ends of improving the quality of peoples' lives rooted in income, status and inner satisfactions derived from jobs. As the quickening pace of global economic and technological change shortens the length of careers, the quality of peoples' lives depends increasingly on life-long learning and repeated upgrading of skills in training programmes.

Evaluation of effectiveness or cost-effectiveness in education and training must be set within the context of physical and virtual learning organisations. Such a context is the integration of real and virtual spaces and channels of communication. These have implications for mapping inter-related sets of processes:

- Organisational
- Administrative
- Teaching
- Learning
- Assessment
- Evaluation
- Social interaction
- Quality Assurance
- Professional Development
- Course Development
- Organisational Development

Studiospace is 'process-centric', rather than 'content-centric' and attempts to achieve cost-effectiveness through both integration of synergistic processes, and enhancement of core processes such as teaching, learning and assessment.

The assessment process in studiospace is an example of a key educational process, requiring a 'mapping' of the interfaces with different stakeholders in the organisation, and the design of shared interfaces with specified fields and protocols for ensuring that the most current records are those shared.

The collaboration, the transparency, the explicit tracking of progression, the recording of progression and the shared access to current details offer a means of auditing/evidencing individual progression and institutional policies for supporting learners.

Evaluation of the potential of such an environment needs to be an iterative process that takes account of potential benefits as they arise, and in collaboration with those involved in implementing it. In practice, many of the potential spin offs (positive and negative) could not have been predicted at the outset.

Action research, (Denzin and Lincoln, 1994), is ideally designed for such contexts, where the change process and the research process are integral to each other, and involve the stakeholders in an ongoing process of analysis, review and re-development.

5.2   ITERATIVE EVALUATION

The intention of the school to include the framework as part of an Intranet, incorporating a much broader range of processes, requires a similar process of on-going action-research - a sort of organisational 'lifelong learning' requiring both a collective process-mapping in relation to core objectives, and networked tools for mediating these.

It requires, in other words, an approach analogous to 'systems thinking' as mapped out by Senge, (1997).

Collaboration - real and networked - is an underlying theme in the systems approach of administrative and organisational practices (getting administrators, technical staff, and faculty to collaborate on implementing learning technologies guided by a shared vision of the learning organisations), and of teachers' and trainers' roles in designing courseware for the classroom, workplace, and Internet.

Links with virtual environments identified in the research in American, Finish and Australian Design Universities and Design Departments are being used to develop further collaborative links, and opportunities for benchmarking best practice and generating innovative approaches to cost-effectiveness in the art and design context, through the use of networked communities of practice.

5.3 PROPOSED EVALUATION MATRIX - TO BE COMPLETED BY 2002 (TABLE 5)

Evaluation Aims/Phase 1	Objectives to evaluate	Evaluation Instruments	Outcomes to evaluate	Target Group

Evaluate the potential for integrating the studiospace virtual learning environment into undergraduate and postgraduate provision in the visual disciplines.	1. Evaluate the potential for the integration of the VLE framework into the teaching and learning context of the organisations.	Literature review
		Focus group feedback
		• Internal
		• External
		Process map
		Case Study
			Educational factors
			Organisational factors
			Design and usability factors
			Costs, benefits, opportunities, barriers
				Development team
				Focus group
				School staff
				• Internal
				  Gray's School Staff
				• External
				  Scottish Art Schools

	2. Evaluate the potential for using the VLE to reduce the staff unit of resource in areas through re-usable resources and integration of pedagogical and administrative processes.	Literature review Focus group feedback Online questionnaire SWOT analysis	Educational factors Organisational factors Design and usability factors Costs, benefits, opportunities, barriers	Admin staff Teaching staff Teaching support staff Centre for learning & assessment Human resources staff
	3. Evaluate the potential of the system for supporting collaborative distance learning with other Art and Design institutions Scottish, UK or global.	Literature review Focus group Case study – Socrates network	Educational factors Organisational factors Design and usability factors Costs, benefits, opportunities, barriers	Grays School of art Glasgow School of art Socrates project network
	4. Evaluate the potential of new technologies to support teaching and learning-centered processes,(learning centered) and user needs, (learning centered) in ways which differentiate it from other 'content-centric' packages.	Comparative review of three categories of VLE's against specific criteria Review of use of networked technologies to support constructivist/learner centered approaches to learning.	Functionality in terms of educational processes e.g. constructivist approach to teaching and learning.	Art and Design Schools Educational/training community
	5. Evaluate the perceived potential of such a system to enhance Professional and Organisational competitiveness through appropriate use of a virtual learning environment.	literature review & analysis Process analysis Focus groups Cost benefit analysis for art and design community	Functionality in terms of organisational processes	Staff, Students, and senior management in Faculty of Design Networked communities of practice Networked organisations

5.4 MATERIALS

1 Online Questionnaire

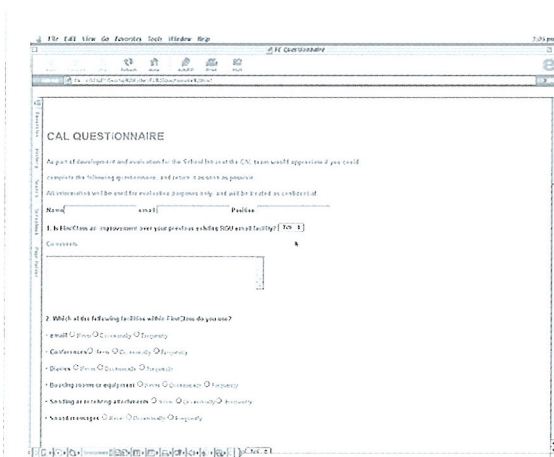This online questionnaire was used to give feedback on a range of technical requirements from staff.

Fig Seven *The First Online Questionnaire*

2 Questionnaire Two

This questionnaire is intended to give us feedback on the extent to which the system will meet the needs of members of staff and students.

First name .... Surname .... Position ....

Please give extended answers that would allow us to make appropriate changes to the system.

1. Does studiospace meet your technical needs?

2. Does studiospace meet your educational needs?

3. Does studiospace meet your administration and organisation requirements?

4. Please look at the three attached tables of technical, Educational, and Organisational needs around which studiospace was designed.

4a. Are there key requirements to be added? (please specify)

4b. Do you feel studiospace meets those needs in general? (please give reasons)

5. Do you feel it could be a useful means of supporting learning and teaching in the Art School? (Please give reasons)

6. Do you feel it could be used to save time through use of re-usable resources?

7. Do you feel it could save time through shared access to current data in administration of courses?

8. Could you please comment on the potential of the specific tools in either (a) enhancing the support for learning and teaching (b) saving time.

Course authoring/lecturespace

Profiling

Assessment matrix

Course administration

Module descriptor database

Figure Eight *Table of Needs Questionnaire*

5.5 DISSEMINATION

Dissemination has been continuous throughout the various stages of the project, with a number of Conference presentations and published papers already achieved and others accepted for 2001 relating to different stages, aspects or elements of the project. Papers have also been submitted to international conferences 2002.

Internal Dissemination and Demonstration

A number of events provided vehicles for this beyond the dissemination in the Faculty itself.

- RGU internet Day - Demonstration and Paper to Representative of All Faculties, Administration, Management and Human Resources
- RGU Year of Assessment Conference (First prize awarded for Poster, Paper and Demonstration by Sally Brown (ILT)
- Demonstration to Senior Management Team
- Demonstration to Human Resources focus group

External Dissemination via Conference Papers and Publications (Table 6)

5.6   SUSTAINABILITY

The project has been adapted as the basis of an Intranet for the Faculty of Design, with internal funding to maintain part of the team to integrate the studiospace VLE with the Faculty of Managment system as a Faculty Intranet. This would be an extended brief to include additional functionalities and tools identified during the research as desirable.

DISSEMINATION (TABLE 6)

Paper Title	Hosted by	Dates	Outcome
An Integrated Generative Virtual Learning Environment for Art and Design	CADE 2001	April 9th - 12th 2001 Glasgow School of Art Glasgow	Presented
Beyond Constructivism: Generative, Networked Environments	ALT-C 2001	October, Scotland	Accepted
ADC LTSN workshop on Virtual Learning Environment Staffordshire University	Staffordshire University	January 19, 2001	Presented
Using Virtual Environments to add value to Networked Communities	AACE (SITE)	June 2001 Tampere, Finland	Accepted
A Portable Document for lifelong Learning. Case study of a Web-based Profiling Tool	PDP in HE Conference case studies publication	March 2001 - PDP in HE Conference, Dundee	Presented
Studiospace: A Collaborative VLE for Visual Disciplines http://www.studio-space.net	ALT-C 2000	September 2000 - Manchester	Presented
Educating the Practice-based Researcher Developing new Environments for Collaborative and Constructive learning	Foundations for the future: Doctoral Education in Design Conference	July 2000 La Clusaz, France	Presented
Virtual University: Real Competition	New Capability, HEC Journal 4 (3),	December 2000	Refereed, Published Journal Article
Competitiveness through Networked Collaboration (Competitividad a Traves de la Cooperacion Online)	ICEED/CIDEE Internat. Consortium for Education and Economic Development (America, Canada, Mexico)	July 1999 University Tecnologico de Tabasco, Mexico	Presented
The Research Master (MRes) for Artists and Designers: A Collaborative Virtual Community using Networked Distance Learning (Poster and Presentation + Demo) http://www.enable.evitch.fi/enable99/papers/papers.html 2. Constructing Competitive Advantage through Networked Learning http://www.enable.evitech.fi/enable99/papers/ure/ure.html	Enable 99: Enabling Network Based Learning Internet. Conferencing Helsinki University of Technology	June 2-5, 1999 UIAH University of Art and Design+ EVITECH Institute of Technology Helsinki, Finland	Online

studiospace

6 Results

6.1   PHASE 1 : INTERNAL EVALUATION

The prospect of integrating the VLE into the organisation raised a range of issues which went far beyond the initial remit of the project. Since the re-engineering of recording, administration and assessment systems for a Virtual Learning Environment required an organisational framework for web-based learning and course administration that was still evolving. This is a scenario that has been identified in a number of reviews of the integration of technology in education, and particularly in relation to distance learning technology. (Bates, T. 1999).

It is recognised increasingly that this requires the development of new strategies and protocols. It is in itself significant that the system is now being funded as part of the Faculty Intranet, despite the implications for 're-engineering' internal processes, and for investment in technical support and staff development.

Within Grays School of Art itself, the development coincided with review and re-structuring to better meet the needs of students and staff on a distributed campus, with limited staff:student resources. This therefore provided a synergy with the aims of the project.

Educational Needs

Although the system was percieved as addressing the correct needs, the usability of the system limited the effectiveness in practice. This was frustrating for users, as they could see how it would have supported activities if specific technical and design factors were addressed.

Collaborative tools, particularly visual ones, were identified as particularly useful, but not sufficiently accessible. It is in this area particularly that the importance of user-interface design and technical issues of access surfaced.

Assessment tools were particularly commented on by staff, given the previous system, where there were a range of different, somewhat fragmented systems, with different records of varying degrees of accuracy. The opportunity for currency, collaboration and transparency of both criteria and marks was regarded as particularly helpful.

Given the currency of profiling and portfolio-based assessment in Art Schools, the potential for web-based profiling, and digital archiving was also seen as a basis for supporting and evidencing both individual development, and organisation support. It was also pointed out that this could be used to support evidence of the kind required in Quality Assurance procedures. Again, however, the design and usability factors prevented adequate use of the tools at this stage, most interest was generated from a range of external agencies.

Organisational Needs

The organisational and administrative tools, while an almost incidental feature at the outset, pulled together resources that staff had already accumulated as part of their own course administration, but which differed from records in other parts of the school and in other parts of the organisation.

The concept of a central, web-accessible resource for specific records was enthusiastically adopted both within and beyond the faculty at an early stage, and the very positive collaboration with staff at different levels was a crucial factor in the mapping of the process and the design of appropriate interfaces, with appropriate access and security features.

Technical Needs

A range of issues emerged during the first phase, where tools and interfaces were added to the existing system to meet a range of additional needs. The technical ones were largely a result of the untested nature of the system.

In some cases the problems arose where specific new tools could not be integrated directly into the studiospace interface, but involved opening a separate window with a separate ID, such as the TeamWave tool. Increasingly, open source tools and systems are becoming available which can be easily integrated without firewall problems, such as the 'peer to peer' tools on http://www.groove.net

Technical problems arose as the system grew, in that databases, tools and links were added as required, and occasionally by different people. 'Rationalisation' of the evolving system became a periodic feature, and it became clear to the whole team that a shared 'map' with regular updates and negotiation of aims and means was essential if the system was not to become unwieldy.

What appeared to be technical problems often turned out to be design problems, in that instructions for access and use were not sufficiently clear to remote users. Capacity of the system is sufficient for the School, however, expansion beyond that size would require migration to another platform such as SQL (Structured Query Language).

Design and Usability

Although user-friendly design and ease of use had been a key objective, it was only through actual feedback that the shortcomings became apparent. While the design was considered to be very appropriate and attractive, it was not functional enough for users. Users found they got 'lost' in the system, and would have preferred a system that allowed them to go quickly from one part of the site to another with one click, and with less animation. The whole site plan was simplified with this in mind for the second phase of evaluation.

6.2 PHASE 2 : STRATEGIES FOR IMPLEMENTATION AND CHANGE

This phase took the team into a process of:

- Refinement of technical and design features identified in Phase 1 with users
- Content development and collation with academic, administration and human resource staff
- Staff development planning

This second stage raised no new technical and design issues, although refinement of details was on-going. Implementation led into an evaluating of the viable strategies for actually implementing a system that required significant educational and organisational change and development. (Bates, 1999).

These change issues are addressed to some extent in the TALENT Project http://www.le.ac.uk/TALENT which addresses organisational strategies for identifying new needs in relation to technology and developing effective and inclusive strategies for change arising from these new developments, including an auditing tool for staff development in the use of new technology in learning and teaching.

The fact that the system had been developed by designers, around the specific needs of artists and designers was seen by the team as a crucial factor in the collaboration achieved with staff in:

- Implementing the system in course plans
- Collaborating in the collation of the hundreds of multimedia resources and course documents now in the system

6.3 PHASE 3: EVALUATING THE POTENTIAL FOR EXTENDING USE AS AN INTRANET

Part of the problem of 'real-world' research and development is the moving goalposts. The system is being further extended as part of an overall University Intranet, and will be integrated with existing systems on an Oracle Server, scaling up will also require translation into SQL.

6.4 IMPLEMENTING THE SYSTEM - WHAT ARE THE ISSUES?

A wide range of issues here were generic to institutions integrating new technology into the curricular and administrative structure, from strategic planning through to resourcing and staff development. These are discussed in the next section 'Issues in Planning and Implementation'.

IN THIS SECTION:

studiospace

7   Issues in Planning and Implementation

7.1   PLANNING

In retrospect, the planning stage was the most crucial one, and one that had to be periodically reviewed with all members of a rather distributed team. The actual development work, and building of the system proved to be the least time consuming. The continuously moving goal posts proved more challenging as changes to a system which was continually evolving proved more time consuming than the initial construction. Assumptions that were incorrect or no longer valid could have serious 'knock on effects' for development timescales.

67

Frequent meetings with a shared 'map' of the constituent parts were essential as the system evolved, and technical, design and implementation tasks were done in different locations. Maintaining a current record of which databases linked to which tools in which ways was essential.

Although this was a system in development, this has implications for any organisation implementing new technology, in that it will continue to evolve in both the technical specifications and the use to which it is put. This requires collaboration and feedback from a diverse range of people if the resulting implementation is to be coherent and effective for all stakeholders, including users. It also requires a framework for implementation and resourcing that is flexible enough to respond to new demands as they evolve. The implications for training and support, both technical and in terms of staff development have been identified in other higher education networks as key areas that were under-resourced in the initial planning phase of technology integration. (Bates, 1999).

It is advisable also to keep a log of how the system is developed and how key links, relationships etc. are constructed during the development of the system in order that the 'map' of the overall environment can be accessible and easily understood by new members of staff. This ensures the sustainability of the project despite staff turnover.

Capturing and using that kind of knowledge for organisational planning is one of the things that the VLE, when fully implemented could in fact help to do. As Drucker (1999) has pointed out, there is a need for the effective capture and sharing of new information across organisations to allow a coherent and rapid response to the changing needs of staff, students and professionals.

7.2   ORGANISATIONAL SUPPORT

Staff development is an ongoing process with financial, organisational and professional implications that require the full support and commitment of senior management as well as staff themselves. All of the issues below have organisational and financial implications that make it clear that the integration of new technology in teaching and learning

cannot be 'bolted on' but involves collective re-engineering of new systems, with adequate resourcing and support from senior management.

The evolving nature of both the processes and the problems require a means of rapid support and championing at a senior level to achieve the speed of response and support required. In the case of Gray's School of Art the initiative came at the end of a period of review of systems, with projects carried out by members of academic and senior staff. The case for change had already been made at different levels and some of the main strategic issues had been anticipated to some extent. This is unlikely to be the case in most contexts.

7.3 STAFF DEVELOPMENT IN USE OF C&IT IN LEARNING & TEACHING

It is worth noting that this implementation implies changes to both the nature of staff activities, and the demand for particular roles and skills.

In the case of studiospace an academic member of staff was part of the team, and able to anticipate the possible concerns of staff with regard to changes. Integration of such a system requires an individual or a team with an understanding of the personal and professional issues involved, and preferably seconded from the target group themselves.

The commitment and collaboration of staff, and the willingness to change was an essential component of the development of studiospace to date, and the plans to further implement it, post project, as part of an Intranet.

Implications for Staff Development

Although use of the system is straightforward, it is still necessary for an induction session with all staff. It became apparent at the implementation stage that some staff required help in the use of email and Internet, for example, and this is a pre-requisite for effective use of the system.

This has implications for staff development support which is not typically available in Scottish Art Schools. This is a key point identified in the VATS project on staff development in use of new technology in the Arts. (http://www.vats.scotcit.ac.uk).

A recent report by Tony Bates (1999), on the implementation of new technology in Canadian universities underlined the extent to which staff development costs had been under-estimated, and consequently under-resourced. This was identified as a key issue that should have been addressed at the outset.

This is already a key issue in higher education in America, and a range of web based auditing mechanisms and tools are

used to profile and organise both professional and organisational development and planning in this regard. Recent initiatives in the UK such as the SCAITS project and the NetCulture project are shown next:

- http://rustysmith.com/needs.htm

Page of links to models, matrices and resources for auditing and developing staff development in use of C&IT for L&T in secondary and tertiary institutions.

- http://www.kpbsd.k12.ak.us/tech/plan/Train/train.html

Auditing tool for staff development in C&IT in L&T (Matrix + model for progression).

- http://www.le.ac.uk/TALENT

TALENT project-Teaching and Learning with New Technology in HE Includes an auditing tool for staff development in use of new technology in learning and teaching.

- http://netculture.scotcit.ac.uk

A Scottish staff development project, mapping and addressing the needs of the staff development community in the use of C&IT in learning and teaching.

- http://www.uea.ac.uk/csed/scaits

Mapping staff development profile in C&IT.

Implications for New Staff Development Roles

Technical staff in some cases felt that their role, and even their job security could be undermined by a system that substituted for them in demonstration of technical procedures. This has implications for the acceptance of the system.

Success also requires the availability of support, particularly as the system develops and has features added. Technical support would also be required on an ongoing basis where additional use was being made of computers. Implementation on a long-term basis implies the need for:

- System administrator - needed to ensure that most current up to date structures are in place software/hardware. Instant responses are required to the system going offline or problems arising.
- Technical support and training e.g. a Help Desk person responsible for troubleshooting and production of associated induction and tutorial manuals not only for the system, but also for skills in word processing, email and use of Internet which cannot be assumed.
- System support e.g. a Database person to maintain the currency of resources and web-based links and resources,

they would also support an organisational system to ensure that staff submit and use the most up to date copies of student and course records and resources for inclusion in this shared resource.

• Staff Development support on production of effective on-line learning materials that use the potential of the system.

Some of these roles are already provided or could be done by retraining of technical staff in roles which are shrinking. Could technical assistants for example be used to input graphics, streaming video, and video introductory teaching, learning sessions for example?

7.4   RESOURCING THE INTEGRATION OF NEW TECHNOLOGY

The point at issue here is that the anticipated potential for saving on the staff :student resource is balanced by the implications for greater support for the technical and educational integration of an evolving system.

In many Universities, including the Robert Gordon University, there is already a commitment to development of a 'virtual' dimension, on the basis that it is essential for survival in a networked professional context. There is an acceptance that provision that addresses the changing needs of professionals will continue to evolve with new technologies, and that there will be associated costs.

Some of these issues are therefore already being addressed across the institution. However studies from other higher education systems in Canada and America underline the extent to which this is undermined by an under-estimation of, and under-provision for support staff, in both the technical and staff development sector. (NetCulture Project Needs Analysis Report on http://netculture.scotcit.ac.uk Bates, 1999).

7.5   STRATEGIC ISSUES - WHO, WHERE, WHAT, WHEN?

A key issue here is the need to link School and Faculty VLEs to the University system in order to ensure compatibility with central databases, and to keep the most up to date University guidelines online.

Many of the issues that arose in implementing the VLE related to roles and responsibilities in a system that must provide accurate information at appropriate times and to appropriate individuals only. For example:

• Who is responsible for the update/upkeep and general day-to-day running of the site, and organisational structures, and protocols that need to be put in place and implemented in consultation?

• What are the key points in the semester where most information would be required to be put into the system are crucial for example? (e.g. Module Content at the start of projects all starting at the same time. e.g. Assessment results all needing to be made available at the same time).

• When staff need to be trained in the development of course content/projects based around the key fields within the system.

• If staff in general are responsible for the quality of information put live onto web? - OR is there are validation procedure? - How is this going to be structured?

• Should content be input by individual members of staff who are responsible for their own areas of study, or should content be validated and input centrally by a core team of staff who are responsible for ensuring Quality, consistency, and basic functionality of information?

• What policy will be in place for sensitive or confidential information, levels of access and structure for editing of information? - Databases need to be protected so that no serious editing can be done. For example the 'Delete' fields should only be accessible to key members of staff.

• What policy will be in place for publication of Assessment marks - when can they be made live - after board of examiners?

• Who will be responsible for general upkeep of student lists, class lists, student progress? Are members of staff responsible or is secretarial support needed? - If so there must be a central database and no duplicate databases, or subject specific databases.

A key point in the success of a system like studio-space will be the quality and accuracy of information that it provides. It must therefore be the most current and up-to date record, and must be linked to central administrative records. This is a key issue for any such system and one which, in practice, involves a review of often fragmented organisational systems. This cannot be done without organisational support and leadership. An element of process re-engineering is unavoidable.

Another factor that becomes apparent when the system is widely used is the degree of dependency it can create, when so many of the activities are mediated by it, and the importance of adequate support for the technology, and the staff using it. What happens for example when the system is down?

71

7.6 TECHNICAL ISSUES

Like many of the issues, technical implementation issues link directly to organisational strategies. In Gray's School of Art particularly, access to computers is limited and this would have to be addressed for full implementation across the Faculty. The hardware and software costs of providing individual access are significant, and in this case are being off-set by support from the University.

Discussions have taken place on the potential for providing staff with laptops (or possibly Palm Interfaces for which a specially designed interface is under consideration). This could be used in studios for supporting learning, teaching and assessment in situ.

The issue of student access is one that has already been raised across institutions as more and more of provision is on-line, or requires shared applications. To a large extent however this is now a generic issue about the integration of new technology in higher education, and not one that is specific to the implementation of VLEs.

7.7 IMPLICATIONS FOR ORGANISATIONAL STRATEGY

It is clear from the feedback from staff and team members, that the issues of implementation centre on the commitment of the organisation and the staff in real terms to such a venture, since it implies significant change at every level, with the concomitant risks and resourcing this implies.

From an organisational point of view, it may be that the costs of not embracing new technology are greater than the costs of resourcing and supporting it.

In many ways, the costs and issues of implementation are therefore generic ones that are being addressed by institutions in any case. They arise from a changing context where organisations are required to adapt rapidly to demands which are constantly changing and evolving. More fluid, flexible and inclusive systems are required to achieve this change process (Senge 1994).

Adding Value Through Collaborative Networks

An overview of successful networks in other educational and business organisations suggests that these high costs can be offset by strategic alliances of organisations as part of a larger network, sharing risks and rewards towards common ends. (Ure and Malins, 2000).

Educational and Organisational Strategies are also reviewed in Ure, (1999) http://www.enable.evitech.fi/enable99/papers/ure/ure/index.htm This identifies the ways in which virtual learning environments in other countries have added value to networked communities by enhancing currency, cost-effectiveness, critical mass and sharing of resources and expertise.

IN THIS SECTION:

studiospace

8 Discussion

8.1 THE POTENTIAL FOR INTEGRATING STUDIOSPACE IN ART AND DESIGN EDUCATION

The perceived potential of the system, and the collaborative approach to implementation, has moved the testing of the prototype to the initial stage of implementation as a part of a Faculty Intranet.

The project will now be internally funded to further develop the studiospace framework, and also to collaborate with other systems within the institution, to achieve an integrated solution across the Faculty.

Issues of institutional policy in this area are now in the process of evolving structures for supporting developments in this area and supporting an inclusive, consultative approach (e.g. Internet Days). A number of initiatives within the university have been pulled together as part of a rolling programme, that will continue after the end of the project to identify wider cross institutional needs and pull together the most appropriate tools and software to this end.

As the tables indicate later in this section, the set of technical, educational and organisational needs identified are met by the system and are being further developed.

8.2 THE POTENTIAL OF THE SYSTEM FOR WEB-BASED DISTANCE LEARNING WITH OTHER ART & DESIGN INSTITUTIONS

Post-graduate

The framework (The studio-space learning environment), is currently being used to deliver part of the web- based Research Masters in Art and Design course (MRes) to a small group of professional designers/design lecturers as a professional development course. One of these works as far away as Vanuatu and the others are working professionals in other parts of the UK.

This was originally delivered by a combination of web-based and CD based resources via the web site http://www.rgu.ac.uk/mres, which is still the home site and provided the pedagogical model for studiospace.. The studio-space environment was tested in sections during development, due to the problems associated with piloting and adopting a system while also delivering a course.

Criticisms related to temporary technical arrangements, many of which were dictated by difficulties outwith the system itself, and relating to integration with, compatibility with or functionality of the wider university systems with which it was required to comply.

Under-graduate (Europe)

In addition to use with under-graduates in smaller collaborative projects, Socrates students sent to partner universities on placements across Europe were also able to pilot the system. They used it to maintain supervisory links with tutors, access, and send assignments and resources, and collaborate with others via the system over the three-month period. In addition to the scope for maintaining supervision and assessment of the work done, those students whose courses abroad were inappropriate or presented linguistic or other difficulties, were less likely to 'lose' a term of assessed work and could be given assignments from home where required.

An additional benefit was the agreement with partners to develop a European 'core skills' element for European Design students that could be accredited, and could actively support the development, capture and dissemination of a European dimension, with resources captured onsite by students and digitally delivered to a shared knowledge-pool. Partner Universities have already indicated a wish to pool resources to mutual benefits.

Again the long-term benefits of the project are implicit in ongoing developments in this area.

Under-graduate (UK)

A number of new courses are actively developing their courses around the existence of the system as a resource and a communication system. The Digital Design and Cultural and Contextual Studies courses will be using the system in different ways to suit their different educational approaches and different types of resource needs.

A Shared Pool of Re-usable Multi-media Resources

The hundreds of multimedia course resources, and the very extensive list of URLs already in the system represent the digital capture of a significant part of the re-usable resources. These are in areas that require significant demonstration and explanation- particularly in relation to use of hardware and software and production or application techniques in this very technical, very applied discipline.

As staff indicated in the interviews, much of their classroom time involved explaining (and reiterating) the techniques and the not insignificant safety aspects of the course.

Indirect Benefits and Cost Savings

If these resources save staff time, the doubling or trebling of available resources at no cost must also represent a potential saving. A spin-off of this system is the potential for collaboration and sharing of interoperable, re-usable resources with any other institution, since no proprietary software or formats are required other than Internet access.

8.3   POTENTIAL FOR ADDING EDUCATIONAL AND ORGANISATIONAL VALUE

As suggested above, the use of technology to support the capture, construction and re-use of inter-operable re-sources across a networked community of practice affords the benefits of strategic alliancing. This is established prac-tice in business contexts, where this is regarded as the key strategy for cutting cost and adding value by sharing of resources, expertise and market share.

In other words, in collaboration, it is possible to substantially enhance the available resources normally both developed and delivered by staff - at no cost. It also offers a much wider potential market for these resources/courses if the collaborating institutions are offering complementary strengths as part of a wider portfolio.

The courses evaluated could not be directly compared with previous years given rapid ongoing innovation, implemented more fully as a function of the facilities now available via studio-space. In other words, the role of the staff as active participants and change agents in what might loosely be described as action research has changed the nature of the object being studied.

To give a concrete example, the new course in cultural and contextual studies is being delivered to all undergraduate students at Gray's School of Art enabled by the potential for easy capture and automatic conversion of lecture, text or visual material into re-usable, inter-operable resources or modules.

8.4   POTENTIAL FOR DEVELOPING A USER AND COMMUNITY - CENTRED ENVIRONMENT

The majority of VLEs are content-centred in construction. The studiospace environment is actually structured around learning outcomes, such that the capture, representation, authoring and retrieval of resources is geared to the indi-vidual learning needs of the user.

In linking with faculty and organisational systems it has also stimulated a dialogue and a re-engineering process that may result in more inter-operable, current and transparent systems that are accessible via the web.

Students on and off campus, professional designers and a range of others in the networked community have the poten-tial to collaborate via studio-space to both capture and generate skills, resources and knowledge by and for the commu-nity, and staff are able to monitor and evidence these processes from the desktop.

8.5   EVALUATING THE UNEXPECTED COSTS AND BENEFITS OF VLES

Higher education institutions increasingly have to consider the direct and indirect costs and benefits of virtual learn-ing environments. Much of the evidence is anecdotal, incomplete or hard to quantify over the short term. Studies to

77

date generally evaluate a limited number of factors, or provide a short-term snapshot of a particular system in a context which is not necessarily transferable. As Nolan (et al 1998) points out the choice of system is therefore more likely to be political than pedagogical.

This section looks at the perceived costs and benefits identified in other studies, and suggests a framework for evaluating, selecting or developing the most appropriate virtual learning environment.

What are the Perceived Benefits?

Universities are increasingly competing on and off line to generate and provide knowledge and skills that will underpin professional competitiveness in a rapidly changing market.

American Universities were among the first to see the potential of networked extended professional communities as a means of sustaining the necessary two-way dialogue (http://ifmsdm.mit.edu/rkt/knowledge/ncml/index.html) that would mediate their competitiveness and currency.

A Virtual Campus is competing on-line with every other provider, worldwide with a similar course. Students are faced with a wide range of possible options, and are about to choose on the basis of cost, currency and quality as never before.

For those Universities entering this on-line competition, it is necessary to have a mechanism for identifying and responding to the emerging needs of their professional community. VLEs and the integrated tools they can incorporate provide a range of potential benefits in this context.

A list of direct and indirect benefits includes:

- Shared spaces for creation, visualisation, modification and development of ideas, concepts, designs, artefacts by a distributed, networked community.
- System for knowledge capture from a networked community in touch with changing professional demands. Informs and supports the institution in authoring, accessing and maintaining the currency of its' marketable knowledge assets.
- Course management tools, and authoring tools for re-useable resources can minimise repetitive or administrative tasks and free staff time.
- Extended opportunities for teaching home, distance and work-based students/staff synchronously and asynchronously.
- Communication in different media independently of time and location.
- Collaboration in different media across shared interfaces/industry.
- Greater transparency of processes such as teaching, learning and assessment for external audit as in quality assurance.

- Greater potential for integration and cost-efficiency of the teaching, learning, assessment and administration processes through shared on-line interface.
- Greater potential for tailoring support resources to individual needs of staff or students.
- Greater potential for capturing, generating, re-using, disseminating, marketing re-usable knowledge assets from the wider networked community.

What are the Perceived Costs?

Cost of the software is often the least expensive item. The institution must assess the cost of a range of other direct and indirect factors identified in a range of studies.

In the UK a key ongoing study is by Bacsich (1999), in a JCALT Report on 'The Hidden costs of New Technology' http://www.shu.ac.uk/virtual_campus/cnl

This explores costing models that take account of five phases of development, from planning, through development, provision, management and maintenance of the technology.

A number of other projects are cited in the paper which outline experiences and approaches from other higher education networks now reviewing the costs and benefits of their own systems.

Key projects cited are:
- Canadian review, 'The costs and effectiveness in technology-based approaches to teaching and learning', (1998)
- Australian NBEET Report on the costs and quality of resource-based learning on and off campus.
- American case study review by Jarrett (1999) on http://www.calstate.edu/special_projects/mediated_instr providing some comparative studies of traditional and online provision.
- Flashlight project http://www.tltgroup.org/programs/flashlight.html also provides strategies for evaluating the impact, costs and benefits .

It is clear from this and other studies that costs and benefits will vary in different contexts, and many of the costs moreover are variable, not fixed. If one were to ask about the costs and benefits of teaching with pencil and paper, the results would be equally diverse.

What is apparent from all the studies however, is that providing computer access to all users was a surprisingly big issue, particularly in the context of art schools where most studios are not computer-based, and many staff and students do not have individualised access. (See the VATS project on http://www.vats.scotcit.ac.uk).

79

Technical Support

Technical support is also more in demand for the maintenance and updating of the system, the larger network and the server(s) required to run the system.

Summary

In the final analysis, the question may not be whether institutions can afford to implement such a system, but whether they can afford not to implement a system that will enhance their responsiveness to the changing needs of their wider professional constituency when facing the demands of a competitive market.

8.6   CHOOSING A SYSTEM TO MEET STAKEHOLDERS NEEDS

What is the 'best' system?

As with almost any educational or technological product, the 'best' system is the one that corresponds most effectively to users' needs, in the broadest sense. (Laurillard, 1993).

At a time where there is a huge potential for choice, the identification of users' needs, in the broadest sense, gives a basis for selection, development and evaluation which is in keeping with the principles of Quality Assurance in both education and business. http://www.qaa.ac.uk/COPaosfinal/genprint.htm

The principles of good practice and quality assurance processes may lead to very diverse solutions, reflecting the equally diverse needs of teachers and learners in different organisations. What will define best practice and cost-effectiveness will be the match to the changing needs of the target audience.

8.7   DID THE SYSTEM MEET USER'S NEEDS?

Consultation with the different stakeholder groups, together with a review of criteria identified as missing from other systems resulted in a summary of key technical, pedagogical and organisational needs on which the value and usability of the system would be judged. (Please refer to point 3.3 of this report).

Did the System Meet the Technical Requirements? *(Please see point 3.3 of this report)*

The system demonstrably meets all the specifications in the table of technical needs. With regard to expandability, there are limits on the numbers that can use the current system, however it is sufficient for School use. Migrating a version of the system to an Oracle server is now underway to optimise scalability if the system is further extended and developed, as anticipated.

In planning this it became evident that the cost and labour saving implicit in integration with the networked processes were dependent on the commitment of resources within the organisation to the re-structuring of existing systems. While this was strongly supported within the Faculty as part of an existing restructuring and the commitment of senior staff, this is an acknowledged difficulty in organisations facing technological change (Bates, 1999).

Educational Requirements *(Please see point 3.2 of this report)*

All the tools identified were developed or further modified and adapted to support the collaborative approaches identified, and their use is being extended within the curriculum in the School as part of a rolling programme that will necessitate more access to computer time for students.

The potential for use of the system via laptops and/or through a WAP-enabled interface in studios is now being actively considered.

An additional tool, 'lecturespace' http://www.rgu.ac.uk/lecturespace, was developed through an Arts and Humanities Research Board Grant to allow the facility of authoring lecture-based resources to include video, sound and visual mapping of lectures as a re-usable resource. Although not yet integrated in the studiospace interface, it was used in conjunction with it.

A CAD space is planned as a further development, to extend the shared functionality of the system. Given the 'modular' nature of the system, other tools can be integrated as required from other sources. Among the recent developments that are being explored are 'peer-to-peer' tools that provide shared spaces for users anytime, anywhere without going through a central server. One such example is Groove http://www.groove.net which are open source (freely available), and can be integrated into such a system without 'firewall' problems.

Organisational Requirements *(Please see point 3.4 of this report)*

The tools to provide for these organisational needs were all developed, and the positive reception, both within and beyond the Faculty indicate that these will be implemented on a wider scale.

The integration of the environment with Faculty and University records and systems was a challenge that underlined the fact that the integration of such technology is not additive - it requires significant organisational adjustment and support given the number of shared systems that support different aspects of the teaching, learning and assessment systems, and the students and course administration systems. (Please refer to the tables in section 3 of this report).

HCI Criteria

The design and usability of the system was substantially altered to fit the expectations and preferences of users. This was an area where hindsight suggests that early trials of the interface would have avoided a great deal of re-organisation at a later stage.

Equally, links from web tools to databases grew exponentially as the project developed and new possibilities and preferences were expressed through trial and use. A rationalisation and re-structuring of the (by now very complex) inter-linking was a necessary stage in what is a collaborative and developmental process.

The initial criticisms that the system was slow and complex to navigate were overcome by a combination of simplification of the whole navigation design, reduction of the unnecessary animation and provision of a range of menu options on each page.

8.8   USING VLES TO ADD VALUE: EDUCATIONAL AND ORGANISATIONAL STRATEGIES IN OTHER CONTEXTS

American higher education contexts, in alliance with competitive business contexts were early adopters of these systems for competitive advantage, using generative learning environments as a means of adding value to networked communities by providing a means of:

- Enhancing quality and cost-effectiveness
- Cutting Costs
- Innovating more rapidly
- Streamlining production processes
- Generating, Capturing and Disseminating skills and knowledge

This was implemented particularly in the engineering, manufacturing and oil and gas sectors in company Intranets and Extranets, (e.g. http://www.teamsense.com).

The argument for use of these environments to match the needs of distributed networks of communities (e.g. education-industry communities) is already well established in America and typified by the example from the Asynchronous Learning Network magazine. (Liston, 1997). This is also available on http://www.aln.org/alnweb/magazine/issue1/consorti.htm, an example is the ALN Demonstration Projects.

Demonstration Projects by Six Members of the Consortium for Manufacturing Competitiveness

The Alfred P. Sloan Foundation has funded six two-year colleges that are members of the Consortium for Manufacturing Competitiveness (CMC) to develop and evaluate ALNs / VLEs to meet educational needs in the technical workplace, with the intention that firms have access to the entire array of ALNs by members of the CMC.

This 'alliancing' model has in fact been exported across the Americas and provides the architecture for a virtual supply chain for providers and suppliers of educational materials, software, hardware and funding.

This has provided benefits for all stakeholders, in addition to competitive advantage in the currency, cost and quality of what is offered in successful co-operative alliances.

Such examples are commonplace in the Americas and Scandinavia, but rare outside the manufacturing and oil and gas industry in the UK and Europe. Until very recently, this strategic dimension, requiring joint action by policy makers and third parties has not been in evidence. Recent developments in JISC, associated with collaboration with the NSF indicate that this is an element that is now being taken seriously into consideration at a national policy level.

8.9 THE ORGANISATIONAL CHALLENGES

The challenge is to form organisations that are able to incorporate these (knowledge generating processes) into their systems, creating the capacity for people to add value to their organisations. With knowledge becoming the basis of global economy, efforts towards developing intellectual capital as a tangible asset are being recognized in organisations that are adapting to the new realities. Collaborative work and learning environments are necessary to support generative learning.

Davis, M. et al Davis et al (2000) ALT-C Conference

Personal, professional and organisational knowledge can be generated, constructed, captured, represented, shared, re-engineered, embedded, or lost, depending on the nature of institutional and social processes within organisations and communities (Prusak, L. 1997). For Universities competing with on-line providers of training in a knowledge economy, the processes by which knowledge assets are generated, captured and disseminated must necessarily be an issue. Generative learning is the term increasingly adopted to describe this process within the learning organisation, (Senge 1990).

Networked technologies increasingly provide the substrate for the recreation of these processes in and through networked 'Communities of Practice', (Bruckman, A. Resnick, M. 1995), in education and business - through virtual learning environments (VLEs), Intranets, Extranets, Supply Chains, the 'wired village', the virtual design studio, etc.

First generation environments were merely information and communication networks.

Second generation virtual learning environments have been increasingly used as collaborative 'shared spaces' where learners actively construct their own learning, as described in the previous section (Jacobsen, M. and Levin, J. 1993).

The third, emerging generation of virtual environments, however, is more typical of networks that are closely linked to industry. These use the network to generate and share 'knowledge assets' to provide professional or competitive advantage for the networked community. (Ure, Malins and Jaegersberg, 2001), and have long recognised the potential of networked technologies to make use of human resources across the organisation both as a means of rapid collaborative innovation and as a resource for enhancing the currency of professional skills and knowledge.

Lawrence Prusak provides a range of case studies (Prusak, L. 1997). While elements of this are evident in American, Finnish and Canadian higher education contexts, where industry is more closely allied with Universities, although it is remarkable that these concepts are rarely evident in educational contexts in the UK and Europe.

Educational and organisational 'added value' can be generated by networked virtual environments for specific professional/business communities, distributed distance learning networks, and regional and national economies.

An earlier case study, (Ure, J. and Malins, J. 2000), of one spectacularly successful virtual learning network in Latin America, implemented a set of financial, educational and organisational strategies from established practices in business, (Senge 1997), where strategic alliancing in networked environments is regarded as the basis of cost-effectiveness for collaborating organisations in a competitive context.

Adoption of these strategies helped them achieve spectacular advantages in:

- Quality, cost and currency of training they provided to the professional community
- Speed of organisational and educational change
- Reduction of infra-structure, and hardware costs borne by education and government
- Benefits to education and industry in the partner regions
- Competitiveness of both small and large regional businesses in international markets

A summary of educational and organisational strategies in other national contexts is available on http://www.enable.evitech.fi/enable99/papers/ure/ure/index.htm

85

studiospace

9   Conclusion

Technology is now becoming an integral part of the collaborative learning efforts and knowledge construction in organisations, especially across time and distance. Collaborative technology (Roschelle, 1996), such as groupware, combines these activities into a dynamic process that people use as part of the shared experience of dialogue, inquiry, and 'mutual knowledge' creation for the construction of 'shared resolutions' to ill-defined problems. (Schon 1983). The technology offers a means and solution for sharing experiences, capturing group knowledge, and improving performance across time and distance.

Davis et al (2000) ALT-C Conference

87

9.1   THE FUTURE OF VLES IN HIGHER EDUCATION

In this sense, knowledge is viewed as socially constructed and socially distributed as the result of group activity. The potential of networked learning environments to support collaborative and constructivist approaches to learning has generated a range of recent papers, particularly in Canada, America, Australia, where geographical distribution over distance necessitated an early adoption of networked technologies as part of regional and national strategies.

Dearing's famous exhortation, http://www.leeds.ac.uk/educol/ncihe to enhance the quality while cutting the cost is one that would be recognisable to analysts of organisational processes in competitive business contexts.   As other providers of web-based professional development adopt such systems, Universities may be obliged to follow, despite the inherent costs, given the growing international competition in this area.

9.2   SUPPORTING EDUCATION-INDUSTRY CO-OPERATION

In a competitive international market, the needs of learners, many of them already in the professional arena, are changing rapidly. Educational institutions competing to provide currency in professional training must be able to respond dynamically to these rapid changes.

Virtual learning environments provide a medium for this two-way dialogue with the wider professional community and maintain the currency of both the University provision, and the professional skills of the professional communities they serve.

9.3   IMPLEMENTING THE CHANGE PROCESS.

Implementing it in the less streamlined context of higher education may be more of a challenge, even where the concept is embraced. One disenchanted lecturer from Brighton University recently described the advent of web-based learning technology in his University as being 'like the introduction of whisky to the Indians'. His disenchantment stemmed from a close look at the demands on American colleagues to offer round the clock on-line support, in addition to 'traditional' duties, and the shortage of adequate technical and curricular support that is actually required to service this new 'engine'.

Most initiatives in this area have been driven by particular misconceptions with regard to on-line systems. A review of the literature, of other initiatives elsewhere, and the feedback from interviewees suggests that despite evidence of real costs there are real benefits that may justify, and indeed necessitate the development and use of such systems. However, they are simply not the costs and benefits most people expect.

Reduction in Staff:Student Resource

The reductions in the staff unit of resource arising from re-usability and inter-operability of materials and staff time in duplication of teaching, are balanced by:

- The cost of staff resources to service the technical demands of the network
- The need for dedicated time for inputting of curricular and administrative data to the databases

Increased Student Numbers

The potential for income from on-line students is balanced by the need to continue to provide feedback and on-line tutorial support if the quality of teaching and learning is to be maintained, and the courses are to both attract and retain students.

Strategic Change

The networked universities who have gained income and reputation from such ventures have capitalised on long term strategic planning to create synergy and cost savings through strategic alliancing that is less typical of a more fragmented HE sector in the UK.

The effective integration of this or any other VLE into the higher education curriculum is part of the wider context of how higher education intends to respond to the challenges of a context it was not designed for.

Core and Wiles in a review of the use of WebCT in Dundee University suggest that integration is crucial to effective planning, but hindered by the fact that 'Universities are information-rich and administratively over-burdened' (Core and Wiles, 2000).

On-line students, for example, cannot be 'bolted-on' to existing systems with minor adaptation. The process in other countries and the results of this study suggest it requires a review of how networks support organisational processes, and how these new networked processes are underpinned by technical support and networked infrastructure that can support constant change.

Other higher education systems in Canada and America, where large-scale change was adopted earlier, provide opportunities to learn from retrospective reviews such as the EVNET project, http://socserve2.mcmaster.ca/srnet/evnet.htm which look back at the costs and benefits of their large-scale adoption of such systems in HE.

89

MAIN REPORT WEB SITES:

- www.studio-space.net (visitors section - open access)

- www.shefc.ac.uk

- www.bestartschool.co.uk

- All URLs cited in this report were available at the time of publication. Due to the nature of web based materials it cannot be guaranteed that the web addresses will remain constant.

10 References

Alderson, J. Yap, K. Liu and H.U. Shah (1998), 'Relating Organisational Semiotics, Process Modelling and Stakeholder Viewpoints to Elucidate and Record Requirements', School of Computing, Staffordshire University.

Bates, T., (1995), 'Technology, open learning and distance education', London and New york:Routledge.

Bates, T., (1997), 'Restructuring the University for Technological Change.' Univ. of British Columbia. http://bates.cstudies.ubc.ca

Bates, T., (1999), 'Managing Technological Change: Strategies for Academic Leaders' San Francisco: Jossey Bass.

Bacsich (1999), JCALT Report 'The Hidden costs of New Technology' http://www.shu.ac.uk/virtual_campus/cnl

Batty et al, (2000), 'New technologies for urban designers:The VENUE project' http://www.jtap.ac.uk/reports/index.html

Beardon, C., (1997), 'Strategies for the Effective Use of Computer and Communications Technologies in Art and Design', Advisory group on Computer Graphics technical report No 31, March 1997.

Beerel, A., (1998), 'Leadership Through Strategic Planning', Thomson Learning Europe, ISBN 1861522088.

Bowman, D., (1996), 'Conceptual Design Space - Beyond Walk-through to Immersive Design,' in Bertol, D., Designing Digital Space, John Wiley & Sons, New York.

Britain, S., and Liber, O., (1999), 'A Framework for Pedagogical Evaluation of Virtual Learning Environments' JTAP Report 041 http://www.jtap.ac.uk/reports/htm/jtap-041.html

Budd, J., Vanka, S., and Runton, A., (1999), ' The ID-Online Asynchronous Learning Network: a 'Virtual Studio' for interdisciplinary Design Collaboration' in Digital Creativity Vol. 10 (4).

Bruckman's Papers on collaborative online communities, http://www.cc.gatech.edu/~asb/papers/index.html

Bruckman, A., and Resnick, M., (1995), Convergence 1:1, pp 94-109, spring 1995.

Bush, V., (1945), 'As We May Think', InAtlantic monthly 76 (1). http://www2.theAtlantic.com/atlantic/atlweb/flashbks/computer/tech.htm

91

CoMantle MLE Project, http://toomol.bangor.ac.uk/comantle

Core, J., and Wiles, K., (2000), 'Embedding Learning with Infrastructure: what happens when a VLE meets University Functionality', Integrating Learning Technology, ALT-C 2000.

Csikszentmihalyi M., (1996), 'Creativity:Flow and the Psychology of Discovery and Invention'.

Davies, Abeygunawardena, Davidson and Nolan, (1998), 'Universities, Communities and Site Building:Exploring Three online learning Systems- Virtual University, WebCSILE & MOOkti'. http://achieve.utoronto.ca/noisey/html/projcool/conferences/ECOO98.html

Davis M, Denning k, Watkins K and MiltonJ (2000), Virtual Learing communities:creating meaning through dialogie and inquiry in cyberspace', ALT-C 2000, Manchester.

Dearing Report, (1997), at http://www.leeds.ac.uk/educol/ncihe

De Bono, E., (1973), 'Lateral thinking:Creativity step by step2', Harper Colophon Books, New York.

Denzin and Lincoln, (1994), Handbook of Qualitative research, London: Sage.

Drucker, P. F., (1999), 'Management Challenges for the 21st Century', Harperbusiness, ISBN: 0887309984.

EVNET Project, 'Evaluating Networked Technology in Canadian HE' http://socserve2.mcmaster.ca/srnet/evnet.htm

Grabinger and Dunlap, (1995), 'Rich Environments for Active Learning' in 'The Changing Face of Learning Technology'. Eds Squires, Conole and Jacobs., Univ. of Wales Press.

Gray C et al, (1996), 'Developing a Research Procedures Programme for Artists and Designers', Centre for Research in Art &Design (CRiAD),The Robert Gordon University Url http://www.rgu.ac.uk/mres

ID-Online Learning Environment, http://www.art.uiuc.edu/idonline

IMS Project, http://www.imsproject.org

Ariadne Project, http://www.ariadne.unil/ch/project

Prometheus Project, http://www.prometeus.org

Jacobsen, M., and Leven, J., (1993), 'Conceptual Frameworks for Networked Learning Environments: Constructing 'Personal and Shared Knowledge Spaces' http://www. edu.vivc.edu/TTA/Papers/JeL-Tel-Ed93.htm

JTAP Reports, http://www.jtap.ac.uk/reports/index.html

Jerrard B et al, (1999), 'Managing New Product Innovation', Taylor and Francis.

Jonassen, D. H., (1996), 'Handbook of Research on Educational Communications and Technology: A project of the Association for Educational Communications and Technology', Macmillan. ISBN 088730687X.

Jonassen, Mayes and McAleese, http://www.icbl.hw.ac.uk/ctl/mayes/paper11.html

Kawalsky, R., (2000), 'Human Factor Aspects of Virtual Design Environments in Education' http://www.jtap.ac.uk/reports/index.html

Laurillard, D., (1993), Rethinking University Teaching: A Framework for the Effective use of Educational Technology, Routledge.

Laurillard, D., and Manning, P., (1993), in ReCALL Journal, Issue 9, November 1993, ISSN 0958-3440.

Laurillard, D., 'Technology Strategy for Academic Advantage', OU (1999), http://www2.open.ac.uk/LTTO/internal/tsaa.htm

Lee and Thompson, (1999), 'Teaching at Distance:Building a VLE', Bangor University. JTAP Report.

Lemke, J. L., (1994), 'Multiplying Meaning: Literacy in a Multimedia World'. Paper presented at the National Reading Conference, Charleston SC (December 1993). Arlington VA: ERIC Documents Service (ED 365 940).

MediaMOO Project, http://www.cc.gatech.edu/fac/Amy.bruckman/MediaMOO

Maher et al, (1995), 'An Experimental Study of Computer Mediated Collaborative Design', University of Sydney Key Centre of Design Computing.

Mayer, R., (1992), 'Thinking, problem Solving, ognition: 2nd edition', W.H. Freeman, New York 91992.

MediaMOO VLE, http://www.cc.gatech.edu/fac/amy.bruckman/mediamoo

93

McMahon, M., (1997), 'Constructivism and the World Wide Web-A Paradigm for Learning', Paper presented to the ASCILITE Conference, Curtin University, Australia http://www.curtin.edu.au/conference/ASCILITE97/papers/mcMahon/McMahon.html

McGreal, R., (1998), ' Integrated Distributed Learning Environments (IDLES) on the Internet : A Survey', In Educational Technology Review (Spring/Summer Edition).

McNaught, C., and Kennedy, P., (2001), 'Staff Development at RMIT : bottom up work serviced by top-down investment and policy.' in 'The Changing face of Learning technology'. Eds Squires, Conole and Jacobs., Univ. of Wales Press.

Milligan, (1999)   http://www.jtap.ac.uk/reports/htm/
• COSE   http://web.staffs.ac.uk/COSE
• Co-Mentor   http://comentor.hud.ac.uk
• Learning Landscapes http://toomol.bangor.ac.uk
• MERLIN   http://www.hull.ac.uk/merlin
• PIONEER   http://www.scet.com
• WebCT   http://www.webct.com
• TopClass   http://www.wbtsystems.com

National Coalition for Manufacturing Leadership (NCML), http://lfmsdm.mit.edu/rkt/knowledge/ncml/index.html

NCML, http://ifmsdm.mit.edu/rkt/knowledge/ncml/index.html

Nolan, J., (1995), 'Transformative and Holistic learning:A Chaotic describption of Curriculum as a Synthetic Eclectic'. Submission as part of Doctoral Comprehensive exams. Availableon http://achieve.forestry.utoronto.ca/tortoise/comps/comp1.html

Nonaka, I., and Nishiguchi, T., (2001), (Eds), 'Knowledge Emergence :Social, Technical and Evolutionary Dimensions of Knowledge Creation', Oxford Univ. Press, ISBN: 0195130634.

Nunan, D., (1988), 'The Learner-Centered Curriculum (Cambridge Applied LinguisticsCambridge Univ Pr (Pap Txt); ISBN: 0521358434.

Pask, G., (1994), 'Conversation Theory: Applications in Education and Epistemology', (outof print), but related articles and reviews of his theories are in the International Federation for Systems Research Newsletter No. 33 - July 1994.

Panel presentation to Conference of Association of CAD in Architecture at University of Washington (1995), 'Learning and Teaching the Virtual Design Studio' http://www.architecture.ubc.ca/vds95

Prusak, L., (1997), ' Knowledge in Organisations', Butterworth Heinemann.

Reeves, T. C., (1997), 'The Internet and Multimedia in Teaching and Learning: Cognitive Tools for the 21st Century, So What Now Information Society? - Interactive Technology in Education 4.-5.4. Conference Publication.

Resnick, M., (1995), Published in Computers and Exploratory Learning, edited by A. diSessa, C. Hoyles, & R. Noss. Springer-Verlag.

QAA for HE 'Code of Practice for the Assurance of Academic Quality and Standards in Higher Education', Url http://www.qaa.ac.uk/COPaosfinal/genprint.htm

Schon, D., (1990), 'Educating the Reflective Practitioner', Jossey-Bass.

Scriven, M., (1969), 'Evaluating Educational Programs', a symposium of The Urban Review , February, Vol.3, No.4, reprinted in Readings in Evaluation Research , Francis G. Caro, ed., Russell Sage Foundation, 1971.

Senge, P., (1994), 'The Fifth Discipline Fieldbook : Strategies and Tools for building a Learning Organisation.' New York, Doubleday.

Shneiderman, B., (1992), Designing the User Interface : Strategies for Effective Human Computer Interfaces.' Boston MA : Addison Wesley.

Shneiderman, B., (1998a), 'Designing the User Interface : Strategies for Effective Human Computer Interaction, Third edition', Addison-Wesley.

Shneiderman, B., (1998b), 'Relate-create-donate; A teachning Philosophy for the Cyber Generation' Computers and Education 31 (1).

Shneiderman, B., (1998c), 'Codex, Memex, Genex : the pursuit of transformational technologies', international Journal of human Computer interaction 10 (2) http://www.cs.umd.edu/hcil/pubs/presentations/genex/index.shtml.

TALENT Project, http://www.le.ac.uk/TALENT

95

TeamSense VLE, http://www.teamsense.com

Tufte, E. R., (1990), 'Envisioning Information', Graphics Press; ISBN: 0961392118.

Ure, J., and Malins, J., (2000), 'Virtual University – Real Competition', new Capability Volume 4 (3), HEC.

Ure, J., Malins, J., and Juwah, C., (2001), 'A Portable Document for Lifelong Learning', Paper for the PDP in Higher Education Conference, Dundee, March 2001 and Conference Case Studies Publication.

Ure, J., Malins, J., Murray, P., and Jaegersberg, G., (2001), 'Beyond Constructivism; Generative networked Learning Environments', ALT – C (2001), Edinburgh.

Vygotsky, L. S., Vygotsky, S., and John-Steiner, (Ed), (1980), 'Mind in Society: The Development of Higher Psychological Processes.', Harvard University Pr, ISBN: 0674576292.

10.1 APPENDIX

Research and Resources in Networked Learning

Updated resources and research on networked learning in general, and increasingly on networked learning in such environments can be accessed from a range of sites such as:

- http://www.jisc.ac.uk This site includes a range of papers and reviews of VLES and will continue to be updated with the new research currently being funded, looking at theory, application, implementation, sots and benefits and future developments such as socio-technical systems.

- http://www.csalt.lancs.ac.uk/nlp Research and resources in on-line learning.

- http://www.nln.ac.uk Networked learning resources.

- http://ferl.becta.org.uk Networked learning resources from FE sector.

- http://socserve2.mcmaster.ca/srnet/evnet.htm Evaluating Networked Technology in Canadian HE.

- http://netculture.scotcit.ac.uk Portal to research projects and resources in staff development in C&IT.

Online Articles that are particularly recommended in this context are:

• http://socserve2.mcmaster.ca/srnet/evnet.htm Evaluating Networked Technology in Canadian HE.

• http://www.cs.umd.edu/hcil/pubs/presentations/genex/index.shtml Codex, Memex, Genex by Ben Shneiderman.

• http://www.cc.gatech.edu/~asb/papers/index.html Amy Bruckman's papers on collaborative Online Communities.

• http://www.icbl.hw.ac.uk/ctl/mayes/paper11.html Jonassen, Mayes and McAleese on constructivism in use of technology in HE.

97

• Milligan C, (1999), JTAP Report 573 (A Review of VLEs) http://www.icbl.hw.ac.uk/jtap-573