The Virtual Design Studio: developing new tools for learning, practice and research in design

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Abstract

The emergence of networked technologies such as virtual learning environments (VLE's) are providing opportunities for the development of new virtual tools to assist design students, practitioners and researchers in exploring ideas with the aid of visualising and mapping tools and providing interfaces that support interdisciplinary collaboration between design teams.

In 1998 a research project was initiated to evaluate the potential of computer assisted learning within Art and Design. This resulted in the development of a virtual learning environment – StudioSpace - designed to support Art and Design students and staff (www.studio-space.net). This paper describes the design process used to develop this VLE and the underlying principles based on a constructivist approach to experiential learning.

The on-going research uses the metaphor of the 'design studio' to explore a range of concepts for generative tools for the representation of design learning, practice and related research. The paper explores some of the ways in which tools such as information retrieval applications, white-boards, visual mapping and digital archives can be combined to provide a virtual online design studio. A further extension to the metaphor provides opportunities for developing new virtual facilities and tools, for example the sketchbook, portfolio, model-making and testing facilities.

The virtual design studio has two potential uses: first, to provide a tool box for the design student/practitioner/researcher/educator to undertake collaborative design practice and reflection using CAD/CAM applications; second, to provide systems that help to externalise design methodologies, thus making it possible to gain an insight into the design process itself. Design iteration and the recording of critical decision paths and reflection points can be achieved through the use of meta-data (such as author, date/time created, version number).

Introduction

Higher Education over the past 10 years has seen a dramatic increase in the introduction of Intranets designed to support teaching and learning. Initially the aim of these systems was to deliver teaching materials such as lecture notes to particular groups of students. As systems have developed the possibility of linking other information management systems designed for course administration and content delivery has grown. The term Virtual Learning Environment (VLE) has been coined to describe such systems. These are commonly accessed using a

standard web browser and do not require a specific piece of software or client application. The Joint Information Systems Committee (JISC) in the United Kingdom has defined a VLE as a system that provides access to 'online interactions of various kinds which take place between learners and tutors' (http://jisc.ac.uk/mle/). As such, a typical VLE is comprised of learning management software providing computer mediated communications (email, bulletin boards, news groups, etc.) and online methods of course delivery.

A JISC Technology Application Programme report (Britain, S. & Liber, O. JTAP report 1999) outlines the benefits of introducing a VLE by reducing the administrative load on tutors thus allowing them to manage their workload more effectively and give more time to individual students. Currently there a large number of existing VLE's or those in development with a trend towards integration with centrally maintained information sources, the emphasis being on the development of systems to support course and institutional administration. In addition to providing opportunities to improve the quality and variety of teaching and learning by enhancing current methods, linking up stand alone VLE's with centrally managed data sources avoids duplication of records and improves the accuracy of the information being used.

This paper describes research that has been undertaken to develop a VLE suitable for use in an Art and Design environment. It sets out the pedagogic theory underpinning this (constructive learning), the use of metaphor in VLE design, and the design process used to develop the system. It speculates on how a combination of available web-based tools, and new tools yet to be developed, can be brought together to provide an environment specifically designed to support collaborative learning, practice and research in design.

Underlying principles of this research

It is generally accepted that learning in Art and Design is experiential – learning by doing, learning through practice – and that project-based work and student-centred learning are key strategies. This kind of learning relates directly to the theory of constructive learning (see Piaget, Bruner, and Vygotsky). Constructivism is based on three key principles; the first being that learning is constructed as a response to each individual's experiences and prior knowledge; the second is that learning occurs through active exploration; and the third principle is that learning occurs within a social context, interaction between learners.

Dalgarno (1996) provides an in-depth explanation of constructivism and its influence on the development of Computer Assisted Learning in which the importance of 'individual knowledge construction' is emphasised. A learning environment based on constructivist principles should facilitate active contribution to a growing 'knowledge base', hence the use of the term 'knowledge building communities' in VLE development. This acknowledges that there is rarely a single response or solution to a given task or problem, and that multiple perspectives and interpretations are encouraged. Such thinking is entirely consistent with learning in Art and Design.

Virtual Learning Environments that apply a Constructivist model to learning have been given the acronym REALs - 'Rich Environments for Active Learning'. REALs are VLEs that attempt to engage learners in 'dynamic, authentic learning activities that increase their control and responsibility over their learning processes while they learn problem solving and collaborative skills' (Grabinger & Dunlap, 1995). An example of a REAL is 'Professional Challenge 98' (Clark, 1998) that uses both a sense of place and play to engage learners.

The use of metaphor in VLE design

The use of metaphor has long been acknowledged as being a powerful means of enhancing our understanding through imaginative strategies (Lakoff & Johnson, 1983; Ortony, 1993). Valuable work has been carried out on

the use of metaphor in HCI, especially spatial and social metaphors as a way of encouraging greater 'naturalness and intuitiveness'. (e.g. Stanford University – http://hci.stanford.edu/hcils/concepts/metaphor.html). Clark and Maher's research (2001) develops the importance of having a "sense of place and playfulness that supports the concept of learning by designing". They suggest that the structuring of a virtual design studio should reflect the characteristics of the physical design studio e.g. a meeting place, a gallery space, a working space including a range of 'tools' for visualising, communicating, organising activities. This 'toolkit approach' (Lin & Protzen, 1997) presents opportunities for further developing a whole range of essential and familiar studio necessities e.g. sketchbook, portfolio, model-making and testing facilities, etc. The closer we can get to what is recognised and needed in order to learn and practice, the more engaging and meaningful the student experience will be.

VLE models past and present

As technology progresses, computer-based systems, such as VLEs, are becoming common and are increasingly being used to support a variety of ever-complex human tasks. Shneiderman (1998) identifies three generations of technology: the early codex model which is largely based on print technologies; Bush's (1945) memex model whereby information is stored, indexed and can be interacted with in much the same way as modern computer systems including the Internet; and a genex model where technology is used to its full extent, not only in terms of supporting the management of information, but in supporting collaboration and creativity.

Using this genex model for a VLE provides a sound framework for the contructivist approach underlying the research and development of a Virtual Design Studio.

In 1998 a prototype VLE, based on this approach, called 'StudioSpace' (www.studio-space.net) was developed using a relational database and web publishing software. This early prototype consisted of a module descriptor database, student records, a resources database, a self-appraisal and assessment database and incorporated Centrinity's 'FirstClass' communication software (http://www.centrinity.com) providing email and discussion tools.

In 2000 further funding was obtained to develop the initial prototype to allow it to be integrated with other University data sources. This revised system is called GraysNet. It provides access to student information, course information, a resources database, course administration tools, a discussion forum and most importantly a project authoring tool. This current system provides resources that are necessarily aimed at supporting course administration tasks in order to ensure there is a smooth integration of existing systems and that tutors can become familiar with the new software gradually, allowing time for staff development to be introduced.

The diagram below shows how information and knowledge is stored and flows through the system and how the user would interact with the system.

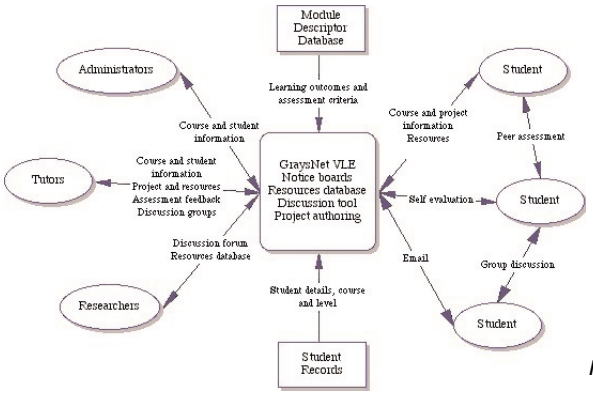

Fig 1 Graysnet VLE showing sources of information flowing between

different users

The process of designing a 'REAL' VLE – GraysNet

In order to design this new VLE system, which would achieve the maximum level of adoption and acceptance by the stakeholders, it was necessary to apply an appropriate design method and structured approach from the outset of the project.

It was felt essential that a user-centred design approach be used and in this case the stakeholders, who would be the end users, were identified as students studying both on campus and at a distance, members of academic staff, researchers and staff from a range of support departments.

The research and development process consisted of three main elements:

- A critical evaluation of existing systems and tools
- A wide consultation with stakeholders
- An iterative development of prototypes

This consultation was carried out using questionnaires and facilitated brainstorming events. The resulting mass of data was subsequently analysed and mapped using a software application called 'Inspiration' (http://www.inspiration.com). This mind mapping software provided an effective method of visualising, communicating and receiving feedback on the design process. As a result, the design methods and tools used in developing web-based systems have also evolved and become more effective in matching user needs.

After a considerable number of iterations a navigation structure was achieved, which provides customised menus based on whether the user is a student, tutor or an administrator. It also became clear that these three groups had very different requirements.

One of the aims in redesigning the VLE 'studiospace' system was to try and establish an intuitive navigation structure. This has been refined using a Cognitive Walkthrough technique (Lewis & Rieman, 1994). A specific task is identified after which all the actions required to undertake that task are listed and four questions are then asked of each action. These are:

- Will users be trying to produce whatever effect the action has?
- Will users see the control (button, menu, switch etc) for the action?
- Once users find the control, will they recognise that it produces the effect they want?
- After the action is taken, will users understand the feedback they get, so they can go on to the next action with confidence?

This type of exercise reveals weaknesses in the usability of the navigation.

The design of the VLE also had to take into account a number of institutional constraints and considerations arising from the need to incorporate a variety of legacy systems and established procedures and also the need to take account of how the new system will be introduced to the end users.

Developing a specification for a future VLE – the Virtual Design Studio

Digital design practice presents particular problems in terms of recording design decisions and development. Exploratory 'marks' and 'sketches' made during the initial research and development stages of a design can

seamlessly become part of the final solution – actually subsumed into the finished artefact - leaving no trace of their previously discrete existence or significance. This creates difficulties in 'reading' the development of the design for collaborators, clients or assessors. It can be impossible to detect when key decisions were taken and why. Practice tends to polarise between virtually ignoring the recording of key stages and retrospectively recreating them if demanded, and printing out or saving every change to the design, irrespective of its importance, resulting in a daunting volume of largely undifferentiated material.

The inclusion in the VLE of a tool interposed between the digital design work and its storage, could encourage the meaningful recording of decisions by, for example:

- automatic time and date 'stamping';
- prompting the designer to make notes commensurate with the importance of the stage reached or decision taken;
- suggestion of suitable locations for the file within a preformed, but customisable, hierarchical structure, encouraging the designer to consider categorisation or classification of the material as part of the process of its creation;
- automatic generation of annotated thumbnails

The LEDA system (Renger ***et al*** 2002) provides an example of the use of metadata to provide information to users in a context specific manner.

In a professional context this 'audit trail' would be of value in allowing specific parties – clients or collaborators for example – controlled access to the design development process for comment, contribution etc. This could be used in evidencing the attainment of key stages in the development of a design for the purposes of releasing fees or achieving milestones as part of a project management scenario. The externalisation of the process could only be of benefit in establishing a mutual respect and understanding between the designer, client and collaborators.

In an academic context, in addition to the implicit and explicit project management enhancements above, the potential benefits of such a tool are even greater in relation to reflection, critical judgement, evaluation, assessment and feedback – self, peer and faculty. The advantages might include:

- guiding the student towards more logical and secure file management – for example assisting in backup procedures or in the maintenance of related file associations in complex projects involving multimedia, web, games etc;
- providing a window on the work in progress which allows the student - or their peers or tutors – to view the development of the design, visually and textually, leading to a clearer understanding of the student's intentions and how well they are being achieved and providing a common and accessible point of reference for discussion, feedback and reflection;
- providing consistency in the way in which digital design work is presented for assessment, minimising the likelihood of inoperability of complex work due to missing files, and clarifying the critical decision path, removing any confusion between development work and the final artefact
- providing a system for recording the dialogue between student, peers or tutors, as appropriate, which acts as a basis for ongoing reflection and guidance and for summative assessment and feedback.

In further developing the design specification it may be helpful to refer to Murphy's Constructivist checklist (1997) – http://www.stemnet.nf.ca/~elmurphy/cle4.html). The category's can be used to assist with the design of the system as well as its evaluation. The category's fall under several headings, which encompass the various elements that may form a learning environment.

Knowledge Base Characteristics:

- Base knowledge construction
- Knowledge collaboration
- Previous knowledge constructions
- Multiple Perspectives
- Primary sources of data

Facilities for Projective Thinking:

- Problem solving
- Consideration of errors
- Exploration
- Alternative viewpoints

Student Centred Learning:

- Learner Control
- Student directed goals
- Apprenticeship learning
- Teachers as 'mentors'

Structure:

- Scaffolding
- Conceptual interrelatedness
- Metacognition

Context Based Activities:

- Authentic activities and contexts
- Authentic assessment

Conclusions

This paper has briefly outlined some of the constructivist principles that underlie current research and developments in virtual learning environments used for art and design. Developing such environments successfully depends on having a clear design strategy and must complement the pedagogical approach as used within the discipline. An approach to learning that includes experiential, problem based, project based, student centred and team based learning.

Web based tools such as generative knowledge bases, discussion tools, white boards, digital archives/libraries can provide valuable resources for students, academics and researchers working in design. Using such systems to help document and disseminate design research provides opportunities for externalising the design process.

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