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The development of a virtual learning environment site to support year one industrial design undergraduates: A case study

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Introduction
This paper describes the development and initial evaluation of a site within a university virtual learning environment (VLE). This was designed to support more conventional teaching and learning on a first year undergraduate ‘design practice’ module. The first use of the VLE site in practice was evaluated from a triangulated set of qualitative data: staff observation, a student questionnaire and student reflections posted on a discussion board.

The paper firstly outlines the background driving the development of the Design Practice module site on the VLE. Secondly the planning and emerging structure of the site is described. Thirdly the strategy and data collection methods to evaluate student use of the site is described. Fourthly this is followed by a discussion based on data gained. Conclusions are then drawn.

Background
The author is the module leader for the first year design practice modules on an industrial design programme. The specific module under discussion has 130 undergraduates, taught in two groups of 65. The contact time has been reduced from one day per week to half a day following university policy to enable staff to have time to engage in research. Nevertheless, the weighting of the module within the programme and, therefore student effort required, stays the same. This translates into a requirement for a further 10 hours of student work beyond the contact time; an increase in non-contact time, pro-rata as the contact time has reduced. This represents a challenge in terms of supporting and directing first year students who, all too often, have minimal time management skills.

The University has developed an in-house virtual learning environment (VLE) called LEARN. Each module leader has control of an internal set of web pages termed a site, which can be used in whichever way they wish, from a basic collection of lecture/presentation notes, to more sophisticated learning environments. There is a discussion facility for each module. LEARN is not a managed learning environment (MLE) in that it is not directly linked to university management and academic record keeping (JISC 2002).

The author had explored the use of this VLE, in support of conventional face-to-face teaching and learning for two years previously. Material had been authored in MS Word and saved as web pages. This experience had its
difficulties, but encouraged the start of a more developed learning environment for the module under consideration. Whilst, as a case study, the work is not directly replicable in other institutions, it is hoped that colleagues elsewhere will find points which will be useful in their own work.

The project started with the coming together of two factors: concern at student ability to manage substantial amounts of non-contact work-load, and the potential of the LEARN site to support and extend student learning based on two years of experience by the author. Whilst a significant amount of staff time had been required setting up, monitoring and maintaining each site, student feedback indicated that there were positive benefits for teaching and learning. It should be noted that the use of a VLE in support of conventional teaching and learning is dependent on good student access to computers with web access. In this context the university has a number of computer suites available on 24 hour access. Added to this a significant number of students now bring their own computers to university and all student bedrooms on campus have links to the university system and www via the Super Janet 2 system.

Planning
The aim was to produce a module VLE site. The central objectives were to:

- Offer a framework for learning via a matrix of tasks within the six week timeframe plus additional, generic, materials to support students in their time and project management.
- Provide a resource base for materials which extend beyond those given in conventional teaching on the module, but also encourage students to look further for resources rather than being a 'one stop shop'.
- Encourage student self-reflection on their learning process

In addition the site would:

- Be ‘accessible’ to students in terms of style and compliant with guidelines for The Special Educational Needs and Disability Act (SENDA, 2001). This is important as, within the university it has been noted that industrial design students have a higher ratio of dyslexia. The relationship between good designers and dyslexia has been well established both in the experience of higher education design lecturers (Brigden 2001) and via the author's experience teaching in this context.
- Offer a peer-support network via the discussion facility. This could be used by students to ask questions of each other and offer tips and advice.
- Staff could monitor student discussion and offer tailored support.
- Support the conventional teaching and learning (3 hours per week contact time) in a nominal 10 hours per week of student non-contact work on the module assignments.

The module was centred on two six week projects; the design of an electronic product and the design of a mechanical product. This study focuses on the former. Essentially, each student was required to design a simple hand-held electronic product. They had to design and prove the electronics on a 'breadboard' and design an injection moulded plastic case incorporating
appropriate ergonomics and internal and external detailing. The assessable components were a design folio including all ‘lash-up’ 3D modelling, an A3 presentation board of the final product, a 3D model in expanded polystyrene foam and a general assembly engineering drawing of the final product.

The VLE offered the opportunity to support students by providing a range of appropriate resources beyond those that could be sensibly given by more conventional means. Some of these resources could be based on the site, such as examples of former work, whereas some could be links to sites such as the British Plastics Federation.

An important feature was that whilst the project was to be completed individually, students were placed in cooperative groups of four and encouraged to support each other in their work. Cowie and Rudduck (1988) offer a comprehensive summary of the advantages and techniques of using cooperative groups at a schools level. Hackman (1983) offers a seminal model of team based work in industry. The groups were selected by staff using a random formula from the class list (Denton 1997). Students were briefed on the purpose of this grouping and the value of experiencing new group formation as against allowing peer choice (Biott 1987). Each group was based at a table (Possible suggestion – based at a table/stationed at a table) which offered sufficient space for four to work and yet maintain good communications. Groups were encouraged to exchange email and mobile numbers to enhance off-timetable communication.

The VLE offered further opportunities for communications in the form of intra and inter group advice and support. In addition staff could take part in discussions on the VLE and react to arising issues. Materials giving advice on group and team working were placed on the site to supplement conventional teaching on the topic.

Another feature was the introduction of professional reflection based on the work of Schon (2003) and Moon (2001). Such reflection goes further than the ‘common sense’ meaning of the term and could be defined as a deeper form of thinking, used in complex or unstructured situations, when the aim is to learn. Moon (idib) considers it to be a ‘process of reorganising knowledge and emotional orientations in order to achieve further insights’ (p4).

Brockbank and McGill (2003) make a good case for the value of reflection in a higher education context. We can juxtapose this with the point that as staff/student contact is reduced reflective skills become more important for the learner. A ‘straw poll’ of the student cohort indicated that none had been introduced to the concept of reflection before. Moon (2001) describes a four stage process for effective reflection:

- the individual makes notes about what/how they have learned
- the individual reflects on that process
- individuals meet in their groups and then share their reflections
- the groups agree a summary of points.
Reflective thinking is a complex concept and one the author anticipated many students would find difficult to grasp, beyond the obvious 'common sense' meaning of the term. The concept was introduced through a conventional lecture but then supported, by the VLE in the manner described in the following section.

**Structure**

The VLE site was designed to complement conventional teaching and learning, not to replace it. The author's personal experience is that direct contact with students is vital, allowing staff to direct but also enthuse and respond. The VLE did not impose any particular format or template on staff. This was a deliberate policy in that it was intended to allow the early users of the system to innovate and then to observe best practice. As such this author had a ‘blank page’ from which to work. MS Word had been used by the author to generate the LEARN sites previously, using the ‘save as web page’ facility. Whilst very simple to use this had limitations in terms of page layout and other features. After attending an in-service course on web page design DreamWeaver MX was adopted. This proved to be much more flexible than Word. However, the author found this package far more difficult to learn to use and that the use of various features were easily forgotten unless it was being used frequently. An academic intending to use this package, unless an existing user of this software, should ensure they have an experienced user to offer support.

The design process for the site followed advice from a number of sources such as the TQEF NCT Project Briefing No. 11 (1999). The objectives given above were addressed by building a site structure. This was done, via a series of iterations, using ‘post-it’ notes on a wall to build ‘site maps’ at a series of levels. The site was laid out around five parallel strands:

- The electronic project
- The mechanical project
- Engineering drawing (used in both projects)
- Support pages
- Reflection

A set of template pages were developed and checked against SENDA (2001) requirements and a standard accessibility test (A-Prompt) run. The pages were given a soft yellow (code #FFFCC) background as this has been shown to assist dyslexics read (Dyslexia Research Trust). A non-seriffed font was used and font sizes were kept a reasonable size.

An index page was set up and followed by a page explaining ‘how to use this site’. The main site map followed the 5 strands. Each strand had its own index page and site map. To assist student time and project management the two projects each had a work plan for the six weeks they ran. This plan gave the essential information of what would be covered in the timetabled sessions, the lectures and what students should cover during their off-timetabled work. The site also contained a set of pages and links to assist students in time management.
One of the strands aimed to support students in the development of skills of professional reflection. This followed the same structure as the two projects: an index page and introductory information followed by a work plan. In the work plan a reflection activity was described for each week. Following Moon’s (2001) process, students were to firstly make notes on and then reflect individually on their work and learning each week. They were then to call a group meeting in which the two strands of the project progress and their learning processes were to be discussed. Each group was then to post a summary of their reflection on the discussion board. This enabled other groups to see and comment on issues, whether they be practical/project orientated or the reflection work. The author, as module leader also read all the group postings and then composed a review of the summaries each week which was then posted on the board for all students to read. This process also enabled staff to gain another perspective on student learning; identifying issues and enabling focussed intervention if necessary.

Planning an evaluation of the site
It is important to plan for the evaluation of any student learning experience during the module design phase. This evaluation needs to be able to see the whole and yet to be able to differentiate specific aspects. One concern for the author was student feedback overload in an era where management systems for Quality Assurance in UK universities result in students filling in a substantial number of questionnaires at the end of each semester. It was decided, therefore, to make the evaluation system as unobtrusive and flexible as possible, while ensuring it yielded information useful for module updating. The method chosen was aimed at a general evaluation of the module as a whole, the VLE site being only a part of the whole. It was intended to use the feedback from the first year of use to both develop the site and to improve the focus for evaluation.

A triangulated (Cohen et al 2003) set of data sources for feedback was planned for the first year of the module VLE site.

- Staff teaching the module were debriefed by the author each week on issues arising during the timetabled sessions.
- The author was also involved in teaching the module and used a process of professional reflection (Schon 2003. Moon 2001) to analyse the module and VLE in use.
- A general evaluation questionnaire was administered to the group: students were asked to list five aspects they enjoyed and found good about the module and five in which staff could improve it. This did not focus specifically on the LEARN site. A total of 95 returns were made from a total of 130 possible returns (73%).
- The site discussion group postings and reflection summaries were built as a log and available for further analysis.

The data generated by these specific methods was qualitative in nature. Analysis was by a simple direct comparison by the author. As it is impossible to present the raw data in its qualitative form within the restrictions of a paper the data is both presented and discussed in the section below.
It should be noted that data generated from the questionnaire was based on each individual listing five good points about the project as a whole and five where improvements could be made. This means that points raised are not bipolar, for example if 50 from the 95 responses stated that they felt a particular aspect was good this does not mean that 45 disagreed. To enable such conclusions to be drawn would require specific questions to be answered on a rated scale. The advantage of the approach adopted was that it raised issues that students felt were important rather than those staff wished to focus on.

Results and Discussion

Design and construction of the site
The site was designed and constructed by the author using DreamWeaver as the web authoring package. The basic structure of the site was relatively easy to put together based on prior experience of using MS Word as a web-authoring tool on other modules. The use of ‘post-its’ on a wall gave great flexibility to insert, delete and re-jig elements during the design stage.

A simple, but appropriate framework for the period of the project was drawn up and communicated in a manner which should be easily accessible to students. A sound resource base was drawn up enabling students to access the majority of materials they would need directly whilst encouraging further exploration via web sites. A reflection section provided further reading on the concept and specific guidance on techniques, a framework to work from, groups to work within and a means of communicating both within and between these groups in the form of the discussion board.

These elements all appeared to be reasonably successful in use. Students were invited to report issues including accessibility via e mail. A few minor issues of linkages failing were raised but discussion during contact time indicated that the site was easily accessible and the framework transparent. These observations were supported by student feedback in the questionnaire and reflection summaries. The question remains as to the degree of support these elements offered. A framework can become over-prescriptive and encourage students to work only directly to it. Similarly over-provision of resources can mean a student is not encouraged to look beyond the VLE site. The feedback and reflection summaries indicate that these elements worked reasonably well, but it would require more focussed data collection such as the use of bipolar questions in the evaluation of the next year’s operation of the module and VLE in order to be more precise.

The objective to encourage student self-reflection on their learning process has been reasonably successful, as confirmed though observation and the student reflection summaries. However, both these sources of data indicate that most students valued the process and some produced insightful reflection, others struggled, typically frequently asking for examples of good practice. This is much as expected by the author. The concept is complex
and the activity required does demand time and support. Time, in turn, is a precious commodity which some students did not see as well spent on reflection. This issue is discussed in more detail below.

Accessibility was a key objective in the design of the site. Of the year group a total of 10 are registered as dyslexic, but with a significant number of others who, while not registered, claim dyslexic symptoms. The author followed ‘good practice’ (TQEF briefing 11) and used the A-Prompt software (see below for reference) to confirm the site met the ‘3 stars’ standard for accessibility. All students were required to use the site and there were no accessibility problems reported by users.

The site also met the other two objectives in that it provided a discussion facility and that this could be monitored by staff and used for tailoring support to suit. Students could, of course, also communicate directly with each other via email, telephone or face-to-face if they did not wish to place their communications on an accessible discussion board. A number of requests and advice were placed on the discussion board by students independently.

As a framework for learning and time / project management.
Reaction to the project in general was positive, with 18 of the 95 responses specifically reporting that they considered it ‘well planned’, one stating ‘it inspires people to push themselves’. Only 38 students specifically referred to the VLE as a positive or to the support it offered. This does not mean that 57 did not, only that students saw their ‘top five’ aspects differently when asked to evaluate the project as a whole rather than just the VLE. Specific scaled questions on attitudes to the VLE would have enabled more precise data to be gained.

A significant number of students reported that the project was good at integrating learning from other modules (68 of the 95 responses). Whilst this related to the project as a whole a significant part was played by the VLE in showing links to other modules and the specific skills and knowledge taught in them, for example electronics, graphics, ergonomics and materials. 36 responses referred positively to the way in which the project took theoretical electronics from the technology module and put it in an applied context.

44 students reported that the project helped develop their time management skills. Two features of the VLE site were central to this: the weekly synopsis of what should be achieved and the VLE site pages on time management skills. It is interesting to contrast this with general observations from the reflection summaries that many students found the work load for the year (across all modules) hard. For example staff report frequent student requests for all deadlines to be in sequence. This, again, emerged in the reflection summaries. This indicates that while students are recognising time management as a significant issue for them and that they recognise the value of the project VLE site in supporting them, some were still struggling to manage their overall work load or appreciate the fact that parallel deadlines are a fact of professional life they must learn to manage. It is interesting to contrast the 11 responses that stated they appreciated the degree of freedom
the project offered. It might be hypothesised that these students were ones who were managing time effectively and appreciated the flexibility of the module workload. This gave them the flexibility to work when they preferred.

The reflective summaries illuminated another aspect of time management; decision making within the design process. Student summaries and staff observation showed that while they saw the framework showing where they should be within their design process many students reported that they struggled with keeping up with the timeline. This was partly due to a failure to take appropriate decisions at the right time and move the design work forward. These students preferred to spend more time on a broad range of basic conceptual ideas, leaving insufficient time to advance the chosen concept to a stage of advanced detailing. To some extent this is a factor relating to the style of design they had been taught in schools. It was very apparent that students came to the university with very little appreciation of the importance of understanding how to design the insides of products despite the fact that product analysis is a part of Design and Technology syllabi in UK schools.

As a resource base
The questionnaire was not very helpful in identifying attitudes specifically to the VLE as a resource base. The responses referred to above indicate a positive response to it as a structure for learning, but few mention the resources within the VLE as a specific one of their ‘top five’ positives. This does not, of course, mean that they did not use them, only that they saw their five priorities elsewhere. This issue requires more focussed evaluation which will have to be done in this year’s project.

A further issue relating to resources is whether the VLE encouraged students to research beyond the resources it contained or provided so much that they used it as a ‘one-stop-shop’. Staff observation and on-going verbal feedback from students appears to indicate that the resources within the VLE were used and appreciated, but more focussed research will be needed to establish how it is used and its strengths and limitations.

Student self-reflection on their learning process
The questionnaire generated 44 positive references to the value of the group reflection meetings. These were fairly general and could encompass factors including the self-supporting group as well as the specific act of reflection. On the negative side there were two observations that group meetings were sometimes difficult to organise and two that ‘reflection didn’t seem very useful’. Three asked for more examples of reflection in practice. The number of negative comments relating to the reflection element of the module, therefore, were minimal.

Staff observation and analysis of the reflection logs posted on the discussion group, however, show that the great majority of students had difficulty in achieving any depth of self-analysis in their reflection. The self-supporting group aspect appears to have been well accepted and the group meetings were the most frequently mentioned positive aspect on the questionnaire.
Analysis of the reflection summaries showed that the majority managed the first step of the four step process as described by Moon (2001); the description of their learning activity. Their analysis of their learning process tended, however, to be far weaker. This is hardly surprising as such analysis is a high level skill and one that it was evident nobody in the year group had been introduced to before.

The most frequent observations from the reflection summaries were:

1. Some students found what they saw as ambiguity in a design process difficult to handle. There were frequent requests for clarification and examples of 'what staff wanted'. This showed two distinct areas: a clear message that students felt there was a specific 'answer' or design approach that staff wanted and would reward; secondly that students wanted to banish ambiguity in their design work from the earliest stages. The group as a whole were unaware of the potential positive value of ambiguity in the early phases of design work (Gaver et al. 2003). This was supported by staff observation of student design work which showed a strong tendency to over-detail initial concept work. This both slowed down concept exploration and tended to mean students would associate concept forms with detailing placed on them at that stage, making concept selection confused.

2. Several students recognised that they preferred to 'take their time and produce a good drawing' even though the work was at an initial concept. This was often related to a perceived need for all images to be carefully rendered even at a concept phase. These factors relate to the teaching on the module which was trying to move students on from an approach adopted in many UK schools which emphasises the design folio as a 'product' in its own right. Students were being encouraged to adopt a more professional approach to design where design drawings and models are used efficiently to move-on a design idea. The fact that a number of students recognised that they preferred the schools approach was, at least, a useful step in professional reflection.

Conclusions
The first year of an undergraduate industrial design programme is a difficult one for students. They are coming to terms with a major culture shock in terms of living away from home (100% in this cohort). In addition the approach to design at the university is a significant step away from the approaches they had been taught in schools and towards that required for professional practice.

This change in culture and the new focus in design, linked to falling contact time with staff, was a central drive for the author in designing and setting up the VLE site under discussion. The author's experience of planning, writing and maintaining the VLE site shows such work to be a very significant task. A lot of time, however, was spent gaining a very basic working knowledge of DreamWeaver. The load would have been lighter had the site been
constructed using Word and the ‘save as web page’ option. DreamWeaver, however, did give far more control over pages. The author is indebted to the colleague who supported him on DreamWeaver issue but would not recommend any colleague taking on anything but the most basic site construction without prior experience or such local support.

The evaluation strategy used had significant limitations, though it was relatively unobtrusive. In the next use of this VLE/module it is intended to adopt a more focused evaluation strategy. Staff observation and records of the reflection meetings will be used again. As the module structure itself appears to be gaining positive feedback from students the focus can switch specifically to the VLE site itself. The proposal is to use Nominal Group Technique (NGT, O’Neil & Jackson 1983). Initially a volunteer group will be used to brainstorm the general question ‘how useful was the VLE site?’ The results of the brainstorm will be used to generate a set of statements which can then be entered into an on-line questionnaire for all 130 students on the module to rate using a 6 point scale from ‘fully agree’ to ‘totally disagree’. This will enable a far stronger and more focussed set of data to be obtained on the way students use the VLE.

The central objectives of the site appear to have been largely met. The framework for learning and time management was clearly well received. It remains to be seen, however, how well the principles within the framework can be used by students in a broader context; can they develop their own frameworks without staff support? As a resource base the site appears to have been well used, though perhaps students tended to take it for granted. Subsequent evaluation needs to check on whether the site prompted students to look beyond the site for research. The development of reflective skills was clearly very new to this cohort of students. In the context of working in small self-supportive groups, though on individual projects, this aspect of the module was highly regarded. Students were, however, finding it difficult to develop the depth of self-analysis that staff require of undergraduates. This aspect of the site requires careful thought before use with the next cohort. Finally all students had to use the site and there were no issues of inaccessibility raised informally or formally.

Clearly such sites are not a way of saving staff time. The first indications, however, are that there is a great deal of potential for supporting student design activity and their growth as designers.
Bibliography


