MyVLE: A case study in building a universal telematic education environment for a small university

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Abstract

Here we report on the design, building and testing of MyVLE, an internet-based e-learning system that provides a universal telematic education environment for educators. The system was designed from first principles with strong support for numerical disciplines integrated at the outset. From a pedagogical aspect the system is unrestricted in so far as possible to allow various theories of learning to be explored as different disciplines may demand. We consider it a universal system in that it supports broad-spectrum flexible learning from purely online to blended, without administrative overhead. Key features of the environment include interactive forums, comprehensive equation support, interactive testing, digital drop off boxes, integration with existing university computer systems, comprehensive marking management and user interaction statistics. The system was built extremely quickly and inexpensively through an agile software engineering process. The finished environment was tested in a pilot study across 2,700 students over 24 months across 29 disparate courses in a variety of modes. Results suggest that the system performed extremely well. This work should be of interest to researchers in e-learning as a consequence of the finished system's modest build cost, rapid deployment, scalable architecture, pedagogical flexibility and recorded impact.

Keywords

e-learning, agile software engineering, virtual learning environment, constructivism, behaviourism, blended mode, numerical disciplines.

List of Topics

Introduction

This paper reports on work carried out at the National University of Ireland, Maynooth to develop a low-cost versatile virtual learning environment suitable for the range of disciplines and teaching methods prevalent at the institute. From the outset it was recognized that a variety of pedagogical leanings and delivery modes would need to be supported without compromising educational quality. The university had a number of programs that were to be taught completely online through the system as well as a larger number that were to be delivered in a mixed mode. The degree of mixing ranged from fully online courses complete with highly interactive components to simple electronic notes distribution and digital submission of assignments. It was also recognized that among the various stakeholders different pedagogical philosophies were evident. This consideration was important. It meant that this telematic environment would have to be rich enough in pedagogical expression to facilitate such diversity. It also became apparent at this juncture that the instructors required an intuitive and usable interface, as a wide variation in their computer literacy was evident. Any difficulties on the part of the instructors on using and expressing their educational styles through the system would degrade the learning experience for all. Aside from these higher level teaching issues, it was important for the more numeric-oriented disciplines that a full range of equations and other non standard notation were supported both in the passive and interactive content (Bourne et al., 2005). This necessitated some novel contributions in content presentation and creation.

A number of commercial / open source options were examined initially. The systems under inspection were Moodle (2005), Blackboard (2005), Claronline (2005), WebCT (2005) and Manhattan (2005). Evaluation was carried out against a stakeholder-derived requirements document (Monaghan, 2005). All the tested systems fell short in meeting these requirements most notably in the lack of freeform equations and diagram support in interactive quizzes. The variations in feature sets are well summarized in (Avgeriou et al., 2001). Consequently it was decided to embark on the design and deployment of a custom solution. This represented a substantial challenge as the budget was minimal and the team assembled small.

This work is best described then as a case study in the design, deployment and testing of a discipline-independent VLE for a small to medium sized university. The main contributions here are the exposition of a VLE capable of embracing a wide range of teaching and learning philosophies, the development of a highly efficient yet intuitive user interface and the realization of interactive components with full numerical and mathematical capacity. In addition this paper describes how through the use of an agile software

engineering process and simple tools a fully featured VLE can be realized rapidly for a university within a small budget using a small team.

The rest of the paper is structured as follows: The next section discusses the pedagogical issues surrounding the core feature set requirements for the design document, next comes a section summarizing the building of the system including toolset and design methodologies. Following this is a description of the look and feel of the finish VLE before an analysis of the deployment schedule; methods of evaluation and results are given. The paper finishes with a short conclusion.

Educational Design Considerations (Theoretical aspects)

The guiding principle underlying the design of the VLE reported here was that it should be driven by pedagogical considerations rather that any demands of the technologies themselves. This is important, as many studies have shown that this is a common complaint of many users of VLEs. Such concerns are responsible for engendering frustration among users with an associated degradation of learning quality. Therefore from the outset the system design was founded upon understanding the varied pedagogical philosophies of learning employed by the stakeholders. In the following subsections some details are given concerning the debate that surrounded the initial design document specification in a spectrum ranging from teaching philosophy to detailed software features.

Pedagogical Philosophies

A typical university has a wide range of disciplines, which through tradition and legacy possess their own accepted and established modes of teaching and learning. Even within disciplines, individual instructors are characterized by differences in educational philosophy. Underlying these variations are respected pedagogical ideas that enshrine some basic tenets of educational practice. It is these basic principles that must not be obscured in any VLE. The system described here was designed to reflect this in so far as possible. To this end attention was paid to the three common philosophies prevalent in the target university, viz., behaviourism, cognitive constructivism and social constructivism. The following subsections describe these psychological theories in turn with an emphasis on their educational ramifications. The associated VLE feature decisions are highlighted.

Behaviourism

Behaviourism as a psychological theory grew out of a reaction against theories of mind common in the late 19th century. The main tenet of their approach was that mental processes could only be understood through objective classical scientific methods, which employed observational quantifiable criteria as evident in stimulus-response experiments.

The main proponent in this realm was Skinner (1976) and his ideas led many to develop theories of education based on such behavioural responses. Under this paradigm knowledge is seen as a repertoire of actions elicited in response to specific environmental stimuli and does not exist in any sense outside this. Acquisition of such knowledge or learning then is established through the instructor presenting the learner with the required stimuli along with the required behavioural responses within an effective reinforcement regime. In terms of knowledge delivery this often implies question and answer exercises with gradual increases in difficulty and frequent feedback, mainly positive and encouraging. The degree of learning is assessed through observable measures such as tests, assignments and examinations. As one might imagine such an approach has most success in well-formed problem domains where there is only one correct answer. This suits disciplines with a heavy emphasis on memory work such as with facts and formulae, vocabulary etc.

The facilities for incorporating this approach into a VLE include the provision of automated MCQ tests, comprehensive grade management with a facility for individual student feedback, interactive quizzes, and performance related content progression. Such functions became part of the core feature set of MyVLE.

Cognitive constructivism

The effectiveness of the Behavioural approach is questionable in areas that require comprehension, creativity and 'gray' answers. In response, educationalists formalized constructivist approaches led by researchers such as Piaget (1968). They argued that learners actively create knowledge themselves and that knowledge is not just a honed set of actions in response to a stimulus. The creation of this knowledge is a product of the learners creating and testing their own world hypotheses. This means that new information is processed according to the learner's individual state and cannot be separated from this. It is a dynamic process of personal trial and error. For the instructor then, learning does not take place through repetition of concepts until the correct response is attained but through understanding what the learner currently knows and then furnishing them with the necessary resources to advance their theories of the world to one commensurate with what is expected. It means the learner must often abandon currently held beliefs about the world as new information and evidence is presented that contradicts their internal theories. This can be quite challenging for the learner, as it requires strong self-motivation. Consequently in terms of instruction while there is still a requirement for memorizing and behavioural activities there is a great emphasis on the instructor encouraging the student to appraise their own beliefs, challenge them in the light of new evidence and acquire new theories of the world which better fit the facts presented. From a pragmatic point of view this requires ungraded assignments and tests that allow the learners to explore and challenge themselves without the fear of negative reinforcement. So too are journaling and diary exercises where learners can record their models of the world at that moment. This allows them to see more clearly any contradictions and indeed in time they can observe their own progress. Essay questions, diagrams and other exploratory and novel expressions of thought are also used to aid in this pedagogical journey. To aid in allowing such a freestyle philosophy MyVLE was to incorporate a capacity for ungraded quizzes and assignments, freestyle responses in tests as well as those facilities provided for under the behavioural doctrine.

Social constructivism

This is a variant on constructivism founded primarily by Vygotsky (1978) who argued that learning couldn't be separated from its social context. Therefore while cognitive constructivists theorized that learning took place through interaction with environmental stimuli alone, Vygotsky felt that culture and language particularly, heavily influenced how a learner's models of the world are updated. Language is essential to our mental model building of reality and, as language is clearly a social phenomenon, then so is learning - it

is co-constructed. From a learning aspect this leads to the idea of dual developmental levels. One level is the *actual development level* which is that at which the learner is capable of independently solving problems. It is this level within which cognitive constructivism operates. The second level is a key contribution of Vysgotsky. It is termed the *potential development level* or more commonly the *zone of proximal development*. At this level the learner can solve more advanced problems through interaction and collaboration with others, usually their peers. The cognitive structures or provisional models of the world are built there only through collaboration and interaction. For an instructor this requires the highlighting of teamwork and interaction with others. This is facilitated usually through group learning with the instructor seeding discussion and gently coaxing and nudging the learning along. For a VLE this is provided for through the provision of forums and chat rooms and is a key aspect of modern VLEs (Dougiamas and Taylor, 2003). Therefore a requirement for MyVLE was that it supported forums as well as group interaction throughout.

Complete feature set

The educational aspects above and a number of other suggestions as decided upon by a representative set of instructors together formed the required feature set from which a design document was created. This is a comprehensive document that encompasses and provides a stable reference for all parts of the software design process. It includes the overall architecture as well as detailed specifications for all features. Presenting this technical document here is well beyond the scope of this paper but in summary the final system was to provide administrative features, integration with existing university database systems, interactive forums, full equation and diagram support both in passive and interactive content, secure logon, assignment management and most importantly content management that was left as simple and robust as possible for staff and students. Once this document was stable the project proceeded to the building phase described in the next section.

System build

After the initial design document was completed to a satisfactory degree work began on realising the system. The development team consisted of a single masters research student with an additional contract programmer for a period of six months. A faculty staff member experienced in a software engineering project leadership role managed the team. Given the small size of the team and the nature of the time pressures involved which required a robust basic system in 12 months a two phase roll-out was envisaged for the system. The first phase would aim to complete an environment capable of the core functionality outlined as follows:

- Secure logon
- Content navigation
- Offline assignment digital drop box
- Self-marking quizzes with batch uploading of questions
- Offline assignment grade management
- Forum

Typical omissions at this stage mostly concerned user-friendly administrator tools. The philosophy at this stage was to present the users with a seemingly complete core system. In the second phase the lower priority features were to be added. This second development period allowed feature requests to be incorporated as well as specific functional improvements. In the next two subsections we will highlight the development process philosophy and the toolset used for the project. These areas are important to discuss in light of the aims of this paper, one of which is to demonstrate how a useful VLE can be implemented with a small part-time team in a short period of time in a disciplined and manageable way.

Software engineering process

The key to successful software development is the adherence to a structured and planned implementation strategy. This is formally known as a software process (Sommerville, 2004). Successful in this sense means to realise a software product that fulfils stakeholders needs and requirements on time and within a labour budget. While there are many paradigms for a software process to achieve this, resource constraints may dictate for one process over another. In our case given the lightweight management structure, small coding team and tight timeframe involved, the extreme programming (XP) process model was chosen (Beck and Andres, 2004). This is perhaps the best-known member of the family of agile software engineering models (Agile, 2005). Its aims, as with other agile processes is to produce success through simplicity, feedback and intensive communication. In more concrete terms XP consists of maximising project success through developing software in short iterations of typically one to four weeks length with an emphasis on testing and code simplicity. Each iteration cycle is concerned with the complete development of functional mini-software modules fulfilling the basic requirements (simplicity). Each of these mini-projects requires planning, requirements analysis, design, coding, testing and documentation. These modules are then tested thoroughly and often (feedback) and can be immediately presented to the customer for assessment (communication). An example in this case would be the implementation of the quiz function or perhaps the forum feature. Each of these were implemented as completely as possible and thoroughly tested with a number of the stakeholders. By involving the end users at these early stages as well as engaging in thorough, usually automated testing, code changes or misinterpreted features could be handled with minimum disruption.

Development tools

Given the XP philosophy espoused above MyVLE was intended to be implemented as simply as possible. In addition costs were required to be kept to an absolute minimum. Consequently a LAMP (Kunze, 1998) architecture was chosen. LAMP is an acronym, which refers to a suite of open source packages commonly used together to run dynamic websites. It comprises **L**inux as the server operating system, **A**pache as the web server (Apache, 2005) , **M**ySQL (2005) as a database backend and a choice of **P**erl/PHP/Python as a scripting language. In our case PHP was used (PHP, 2005). It should be noted that with very little configuration the completed MyVLE was later successfully run on a Windows NT server. The forum support was provided through the reuse of an open source project phpBB (2005). In addition for software of this scale and complexity, version, code control and bug tracking are of paramount importance. The Concurrent Versions System (CVS) (2005) was used for this versioning and source control while Bugzilla (2005) was employed for handling bug notification and fixes. Both packages are open source. Table 1 summarises the suite of tools applied.

Purpose	Software	Initial Version

Server-side scripting language	PHP	4.3.1
Database	MySQL (with transactions)	3.23.56
Webserver	Apache	1.3.26
Forum	PhpBB	2.0.4
Bug tracking	Bugzilla	2.16
Source code control	CVS	1.11

Table 1. Software tools and versions used in the development process.

At this stage development could begin in earnest. While automated testing posed some difficulty the XP process in conjunction with the LAMP architecture allowed a realisation of the VLE within the required timeframe. While a detailed account of this experience is beyond the scope of this paper the interested reader may find more information in (Monaghan, 2005). The next section will serve as an exposition of the look and feel of the finished system.

A walkthrough the finished system

The primary stakeholders involved with MyVLE are the course instructors and the students themselves. As a means of conveying a sense of the environment, in this section we will endeavour to furnish these details in a clear manner by highlighting individual portions of the learning system accompanied by screenshots. As not all aspects of the system can enjoy an exposition within the confines of this paper we will not discuss the substantial statistical tools integrated in MyVLE nor indeed shall we discuss in any depth the system administrator's interface. Again readers interested in more comprehensive details are directed to (Monaghan, 2005). Instead we will concentrate on those aspects most germane to our goal of highlighting the system's basic pedagogical function and ease of operation.

To begin we will highlight the course manager's view of the system once they have initially logged onto the system. A course manager (CM) is this case is typically the instructor i.e. the person who will organize and deliver course content for one or more modules. Figure 1 below illustrates a typical view associated with one of the engineering faculty instructors. The screen is uncluttered, clear, simply linked, with no deeply nested links required for common tasks. Such a robust interface is part and parcel of modern interface design practice (Evans et al. 2004) (Nielsen, 1999). High-level functions are kept visible on the left hand screen while pertinent information for the instructor regarding forum activity and messages crown the top of the central area. This highlighting of forum activity is one of the lynchpins of a social constructivist approach to learning where the instructor is more oriented towards learning facilitation than knowledge delivery. Below this area is a listing of the courses under management along with top-level course description documents such as syllabi or institution-specific documentation. Finally at the foot of this figure we can see other courses that the instructor may view for their own interest.

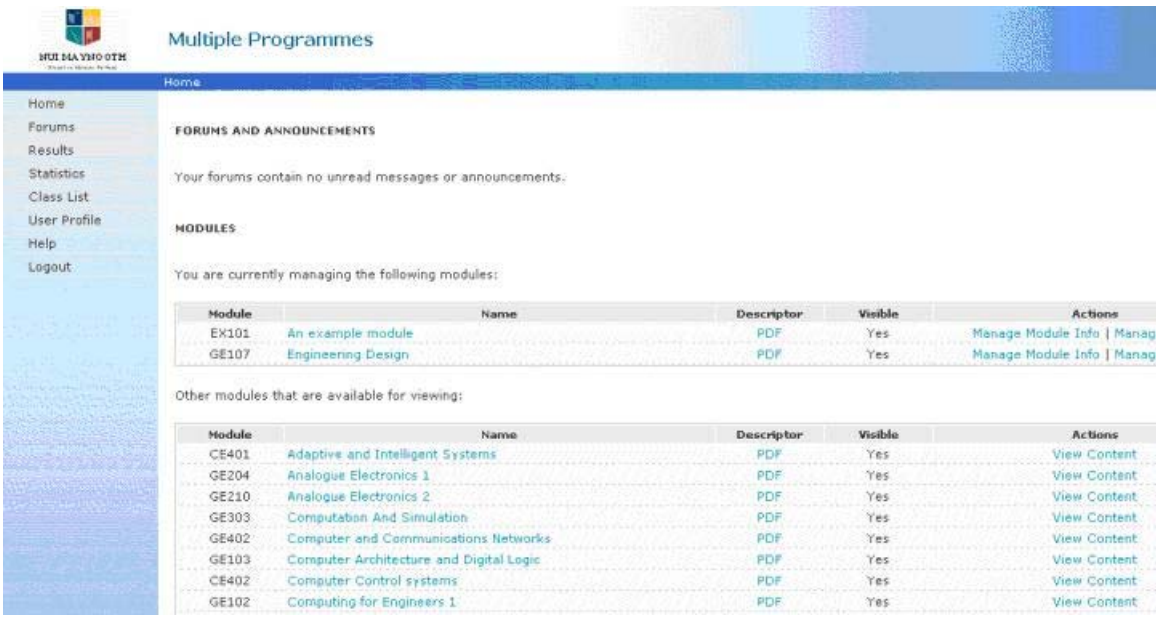

Figure 1. The primary screen for course managers.

The next view we present is the content editing page from which the CM can add, order, alter, group, remove and condition atomized learning objects such as html documents, interactive quizzes, offline/online assignments, portable document formats (PDFs), etc. Figure 2 shows this page for a typical module (course). It is worth noting that the operations available are fundamental in structuring any course and requires for their ease of accessibility a parsimoniously structured view unhindered with unnecessary clutter. We feel this was achieved. The student view is almost identical except that all editing links are removed yielding a yet more frugal display. Another notable feature worth highlighting in the context of the student view is that if an instructor has an easily printable version of a content item such as a PDF version of a slideshow presentation then this is immediately associated and made available for the student. This feature is very popular among VLE users who have been shown in many studies to prefer hard printed material in many circumstances (Monk, 2005) (Chang 2003).

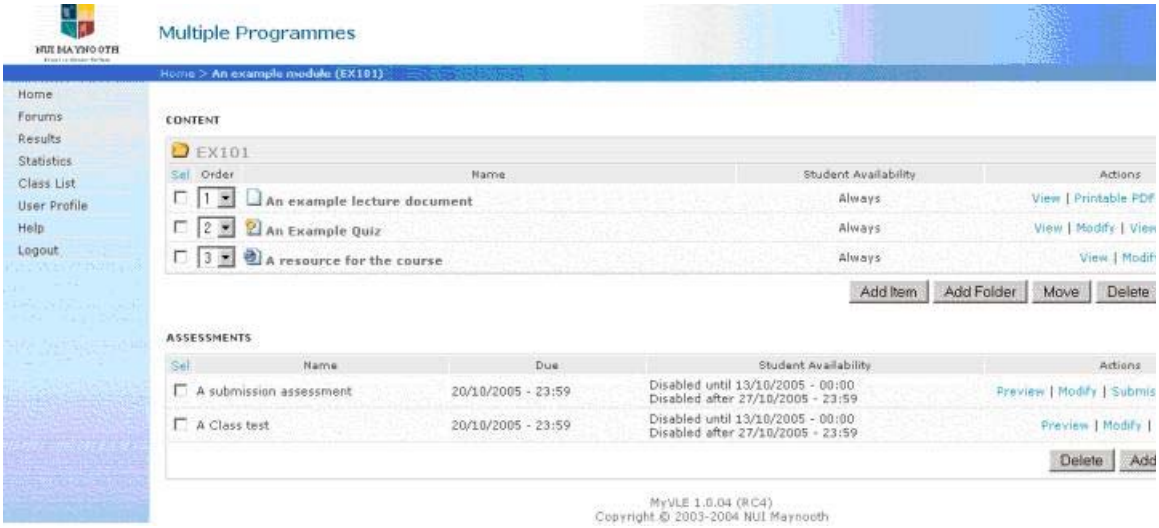

Figure 2. The content editing view for individual courses.

It is important for the purposes of discussion to recognize two forms of content that differ in terms of their interaction with MyVLE – inert elements and active elements. Inert elements are content items that do not interact with MyVLE such as standard html content. This is not to say that these items are not interactive from the point of view of the learner, they may well be, such as a dynamic html item or indeed Flash content and so on. The key difference is that there is no explicit management of the interaction from the MyVLE system itself. Active elements are different and manifest themselves in this system as assessment items. Figure 3 illustrates the active element creation and modification screen. It can be seen that the double-tabbed interface allows both interactive quizzes and offline assignments. Offline assignments are clearly part of the blended or mixed mode philosophy and the implementation here allows great variance in its handling through allowing optional electronic submission, optional deadline management, integrated grading and temporal gating of delivery and submission. A more conventionally active element is the quiz item. This content item is generated from a template that allows multiple questions to be automatically and randomly selected from a pool with an optional time limit. Answers can be given at the end along with hints when incorrect answers are presented. Both multiple choice and freestyle answering is supported although obviously automatic marking can only operate in the former. A slight variant on this learning item is what we term the class test, which can be used for more formal examination purposes. Here only one attempt is allowed per quiz. The creation of these question pools is based on a MS Word template designed by the authors. Full support for equations and images both in questions and answers is allowed with no restriction on their number or position. This contrasts rather sharply with other popular VLEs where a lack of flexibility in question and answer construction hampered attempts to introduce these systems in the science and engineering faculties at this institution.

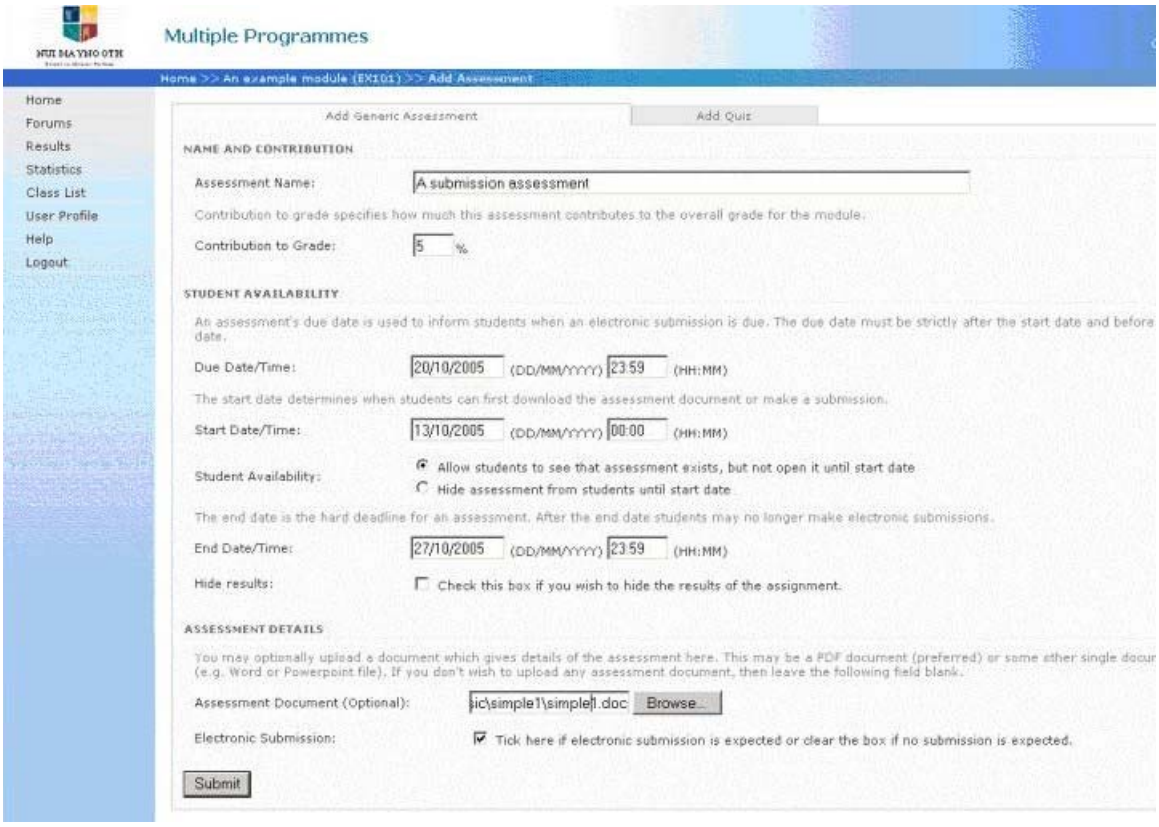

Figure 3. Adding assessments and interactive quizzes.

We now will expound further on the assessment elements as we introduce the optional grading management system. This is an important part of any VLE and one that requires some attention if universal acceptance is to be attained. Figure 4 illustrates visually how this is achieved. The system allows marks to be included or excluded from any final average for a student (behavioural or constructivist) as

well as communicating the mark automatically to the student with an associated comment if deemed necessary by the grader (behavioural). These results can also be hidden from the students.

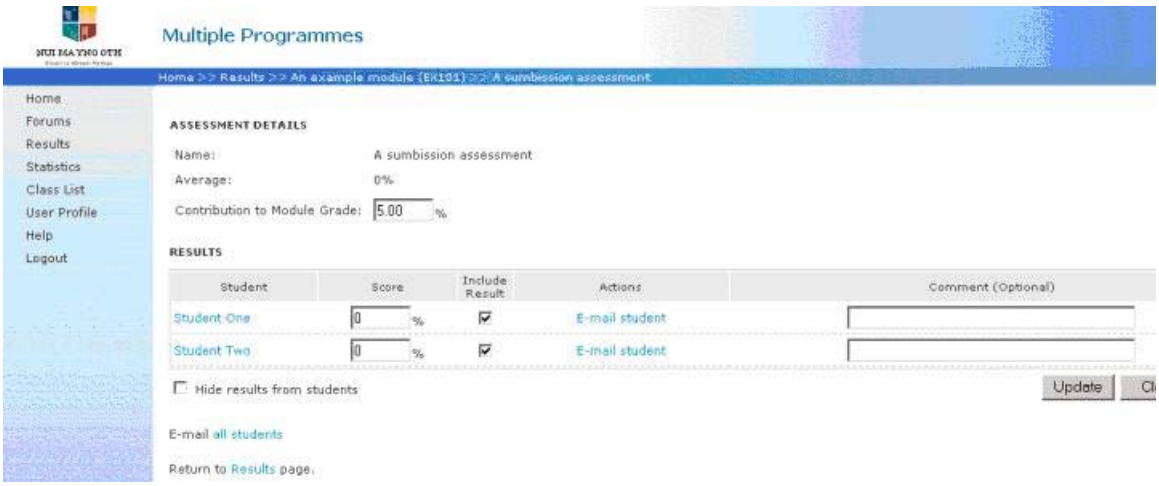

Figure 4. Adding grading information to assessments and interactive quizzes.

As one might intuitively imagine clicking on a student's name in this section will list all the students marks so far in that course. While augmentation of the system with even more sophisticated options is always possible it was found through feature requests and feedback that the configuration as highlighted was more than adequate for all stakeholders needs in this case.

Finally a word on the forums used in MyVLE. The forums are a very important aspect of a VLE regardless of whether a social learning environment is being cultivated or not. On a basic level it allows global announcements to be made regarding matters of concern to all while in more sophisticated scenarios it allows group collaboration, independent learning and instructor guided discourse. Consequently the well written, open source phpBB system was used. This GPL software was smoothly integrated into our system by virtue of its identical software makeup (php with MySQL) and its rich feature set allowed all sorts of possibilities in terms of interaction. The interested reader is directed to (phpBB, 2005) for a demonstration of this software.

We will now proceed in the next section to discuss the deployment strategy for the system, which will include some details on the testing and evaluation mechanisms used.

Deployment, Evaluation and Results

We will discuss here the deployment period September 2003 through to June 2005. Over this time there were three production deployments of the software. Each of the deployments was targeted at a different subset of the undergraduate population. Extensive evaluation was performed throughout.

Deployment scheduling

The initial rollout for the system was for the Degree Extension for Technicians (DEFT) program. This is a distance-learning initiative, which offers the last two years of a bachelors of engineering degree in electronic engineering online. This program enabled essentially the single mode test experience for the system. No sooner than instructors at the faculty of engineering had gained experience with the DEFT implementation of MyVLE the system expanded to accommodate the on-campus students in engineering. This deployment phase was termed 'In-house'. It quickly became very popular among the staff and the undergraduate body, eliminating over one semester, any dependency on personal staff websites. It was during these first two phases that the science and engineering friendliness of the system was established. The final phase conducted as an e-learning pilot brought in some 2,700 students across such diverse departments as geography, biology, education, engineering, economics, sociology, german and modern history. There were 70 course managers, 130 courses and 1.4Gb of content involved at its zenith. This final phase confirmed the system's ability to operate as a blended mode delivery mechanism over a broad spectrum. Some course managers used the system as simply a secure means of collecting assignments while others fully embraced its ability as a total distance-learning tool with a near continuum of usage patterns in between.

Figure 5 summarises the deployment schedule while Table 2 displays some version statistics.

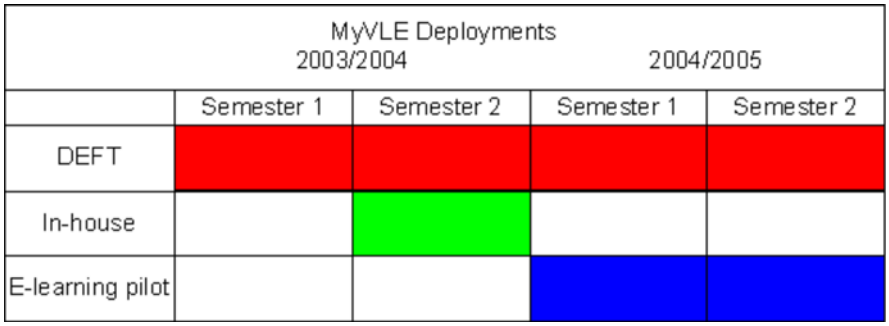

Figure 5. Timescale for the MyVLE deployments.

Table 2. Deployment key statistics.

Deployment	DEFT Yr 1	DEFT Yr 2	In House	E-pilot

Students registered	8	10	117	2664
Course managers	7	13	10	69
Courses	9	15	19	129
Content - MB	77	133.2	104	1320
Average number of logons per student	162	113	26.25	25.5
Average number of logons per course manager	31.3	32.1	45	54.6

Evaluation Methodology

To evaluate the system, both objective and subjective measures were taken. The simplest objective measure for the usage of the system was through analysis of server log files. From this, patterns of interaction could be ascertained in terms of times and duration of access as well as shear volume. In addition it was important for us to assess learner and instructor satisfaction with the system. The VLE was attempting to be all things for all instructors and students so only feedback questionnaires and other comments could assess this. Online surveys were conducted using a comprehensive questionnaire detailed in (Monaghan, 2005). Due to space considerations only a sample of these questions will be discussed in the next section.

Results and Discussion

The efficacy of MyVLE was conducted through analysis of both log and questionnaire data. Given the aspirations advocated in the introduction it is worth analysing the log information to demonstrate first of all that the system was being used extensively and secondly to determine what learning patterns were visible. This is best illustrated perhaps with Figures 6 and 7 below.

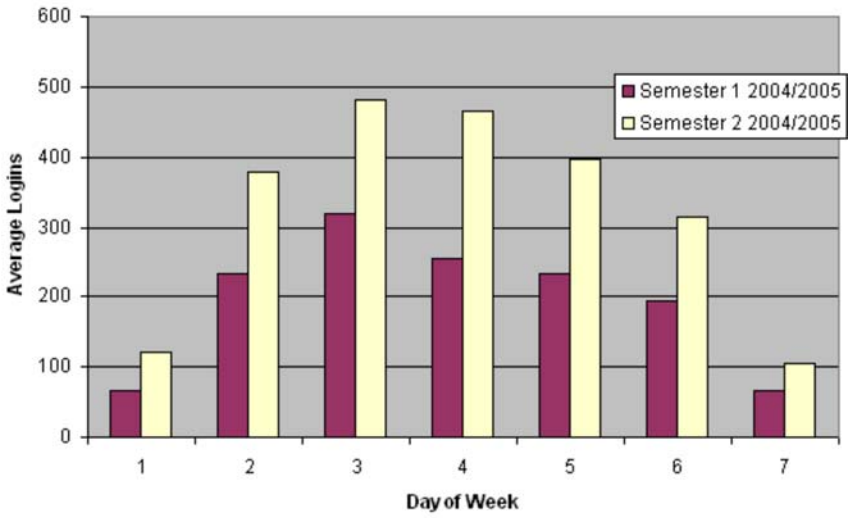

Figure 6. Learner logon statistics over an average week.

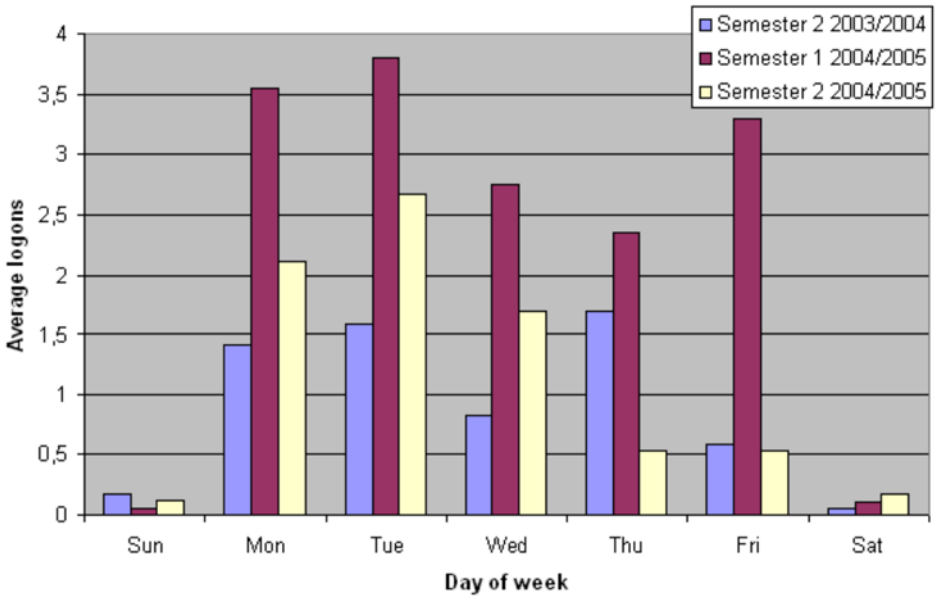

Figure 7. Instructor logon statistics over an average week.

It is clear that the system was heavily used by both staff and students with peak activity occurring midweek. Interestingly instructors tended to use the system along a normal working week while students on the other hand had a more flexible and smoother distribution of working times.

More direct feedback was available using the results of the feedback questionnaires distributed to the stakeholders during this same period. Rather than display all the results here the averages for a core set of questions are shown here in Table 3. The most gratifying of the results in this table are those for ease of site access and navigation as well as the format of content - in this case HTML and PDF. It is apparent that the students found the site simple and intuitive to use.

Table 3. Learner feedback. Statements rated from 1 (poor) to 5 (excellent).

Question	DEFT, Yr 1	DEFT, Yr 2	In-house	E-pilot
Accessing the DEFT site was straightforward and reliable	4	4.75	4.5	N/A
The forums were useful	4	2.5	2.2	2.9
The site was easy to navigate	4.1	4.5	4.2	4
The self-assessment quizzes were user friendly	2.6	2.75	3.3	2.7
Assignment grading was useful for monitoring progress	2	2.5	4.5	N/A
Content (HTML and PDF) formats were satisfactory and sufficient	4	4.5	4.2	4.2
The self-assessment quizzes are generally useful and relevant	2.8	4.5	3.2	N/A

In addition learners were asked for comments on the system. The more obvious discrepancies between scores in Table 3 are best discussed in light of these comments, as analysis in isolation is not particularly elucidating. In particular they were asked what they thought were the most and least valuable aspects of the software. While of course these were varied in their tenor there were a number of recurring sentiments some of which will be highlighted here. In what follows actual representative student responses (in italics and numbered) are highlighted as these best describe the prevailing attitude of the users.

Ability to find out information very easily. When and where it suited.

Access to course content from any location (1)

The fact that the site was accessible from anywhere pleased the students. Some of the content previously available to students was only accessible from within the university. There are only a limited amount of computers available for the students to use on-campus. Giving students the ability to access material off-campus meant that some of the tailored learning done by distance students was possible.

The availability of averaged grade scores (2)

Ability to receive assignments online and to be able to submit them

securely. Also the secure presentation of individual marking (3)

The grades management feature was singled out as having particular value to the students. Students liked the ability to see up-to-date grades for courses they were taking so they could assess for themselves how they were doing. In fact, one of the biggest complaints from students was that course managers did not always use this feature or did not use this feature enough. This perhaps explains some of the low scores given in Table 3.

At the core of MyVLE was the provision of course materials.

All course material available on the one site (4)

Lecture note access allowed better use of lecture time! (5)

Being able to obtain lecture notes when unable top[sic] attend the lecture itself! (6)

By being able to obtain notes before a lecture, the students felt they could concentrate more on the material being presented rather than having to attempt to take detailed notes as well. If a student missed a lecture for whatever reason, being able to easily obtain the missed notes was a boon. A worry for the course managers with providing notes was that if a full set of notes were made available before a lecture, some students would be inclined not to attend. To help prevent absenteeism, some course managers would place an incomplete set of notes on MyVLE before a lecture and then a full version afterwards. As exams approached for the students, the fact that MyVLE provided a centralised repository of notes meant that students did not have to navigate multiple sites to obtain the same information.

Only one of my modules uses it! (7)

*I feel that there are many features incorporated into MyVLE which are not being utilised properly by staff. *Regular* online quizzes would be a welcome addition... Additionally, there isn't much point in having a VLE if not all staff put their course material there! Also, why [do not] staff put up scores/grades for practicals, worksheets, lab reports, etc I really do feel that many features of MyVLE are wasted - many of the areas are empty!* (8)

The single biggest complaint from the students was that MyVLE was only being used as part of a pilot scheme and not as a fully-fledged initiative across the university. Many students wanted to see more (if not all) courses using MyVLE. This suggests that students can see the value of VLEs without being prompted and their usefulness extends well beyond just providing a method for distance learning.

Not all of the course managers used MyVLE fully. This is because many were new to the concept and were learning themselves how best to present their content. When the students observed some of the course managers using the provided MyVLE functionality, they began to demand the same from all of their course managers because they perceived usefulness from MyVLE.

On-campus students are used to being taught in a face-to-face manner.

It makes the University Experience less personal as it is hard to build a rapport with a machine (9)

There was a feeling of disenfranchisement among some students. This can be compared to the difficultly distance learning students have in feeling like they are actually part of a class (Johnson et al., 2002).

For me the most beneficial aspect was the forum as we could use it as a notice board to keep people up to date with everything. It was also great for discussions or arguments (12)

The forums have little info and are rarely used I feel this is because the forum section of MyVLE is difficult to navigate and a bit convoluted (13)

Opinion was somewhat polarised on the usefulness of the forums. This seemed to come down to how active the course manager and other students were on the forum. Bennett and his colleagues (2001) would suggest that course mangers could encourage discussion by starting relevant topics and specifically asking the students for comments. This was not always done as obviously not all lecturers subscribe to (or perhaps have time to engage in) social constructivism. That said forums, were an easy means for the students to communicate with each other and with the course managers for routine class announcements.

Feedback and evaluation was also sought from the course managers. A summary of their responses is given in Table 4.

Table 4. Course manager feedback. Statements rated from 1 (poor) to 5 (excellent).

Question	Rating
Overall quality of the application	4.5
Completeness of the application (range of features)	4.0
Ease of use (was the user interface intuitive/self explanatory)	4.0
Efficiency of user interface (did operations generally require few steps?)	4.2

Again it is clear here that the instructors found the software useful and easy to use for their course material.

From consultation across and within various departments it was also clear that different pedagogical philosophies were well catered for without compromise. This aspect was clearly facilitated through the availability of the forums, interactive tests, quizzes and mathematics support. It was clear these features, their ease of use and of course the liberal yet uncomplicated approach allowed by the software for content construction allowed the system to win over the university body rather quickly.

Conclusion

The main objectives for the VLE, as stated in the introduction, were all met, albeit with varying degrees of success. MyVLE is able to deliver a wide range of document types remotely to the student body, who can then view them as their schedules allow. Since MyVLE can handle a range of documents, the course managers can use a variety of methods (e.g. dynamically rendered MathML, images, embedded MathType objects) to display equations within their course notes. Students are able to submit assessments completed offline to an electronic drop box, for collection by the course mangers individually or as a group. A basic form of online testing is provided, which has a quiz template allowing the batch uploading of multiple questions. Students and course managers can communicate with each other via a forum (however this was not used to its fullest extent) and the course managers have access to the student's email addresses for full communication.

The system was deployed both as an online only educational environment and a fully blended system with no additional overhead. Scalability was excellent and the software remained robust. Psychologically varied theories of education were catered for and delivered as per the prevailing attitudes of the various departments, including heavily numeric areas such as engineering, which were facilitated through comprehensive equation and diagrammatical support. The cost of the system to the university was minimal and most beneficially a platform for further and more innovative open and distance learning research is now available for future use.

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