

MyVLE: An Engineering-centric e-learning Platform

Karl Monaghan, Rudi Villing and Tomas Ward

*Department of Electronic Engineering,
NUI Maynooth, Maynooth,
IRELAND*

*E-mail: karl.monaghan@eeng.nuim.ie,
rudi.villing@eeng.nuim.ie, tomas.ward@eeng.nuim.ie*

This paper reports on certain key aspects of the design, building and testing of MyVLE, an internet-based e-learning system that is used at NUI Maynooth for the delivery of a remote program in engineering education. The system was designed from first principles with strong support for numerical disciplines integrated at the outset. The paper will describe in some detail the most novel components of the software viz. the engineering science focused interactive quiz feature and the results management component. Further we describe the background to such learning environments, the rationale behind our decision to custom-build a solution as well as drawing focus to the field of distance learning in engineering education in Ireland. This work should be of interest to researchers in distance learning in engineering and the sciences as a consequence of the finished system's modest build cost, numerical discipline support, scalable architecture, pedagogical flexibility and recorded impact.

Keywords – distance learning, virtual learning environment, e-learning, interactive testing.

I Introduction

The delivery of education over the internet is nothing new - indeed distance education in general has been pursued for more than a century. However the satisfactory delivery of education using this pedagogical paradigm has been elusive in the sciences and engineering particularly where the internet is concerned. The lack of flexible support for equations and diagrams was the most notable failing. In an attempt to deliver engineering education remotely at NUI Maynooth a new internet-based application was developed to remedy this situation and deliver an appropriate learning experience. Here we report on certain key components of the finished system called "MyVLE". For the purposes of completeness we will also endeavour to provide a succinct history of distance education before proceeding to describe the key components of our final system.

Distance learning has been around since it became feasible and economically viable to distribute media over wide geographic areas. Not surprisingly it was the creation of national postal services that coincided with the advent of such a pedagogical phenomenon. Using this distribution

channel distance learning provided a means of educating a disparate populace without the need for locally based facilities and resources. As other technologies were developed that allowed for rapid communication over large distances (such as radio and television), they were harnessed to improve the dissemination of material [1]. The main drawback of the radio and television approach was that there was little interaction between the student and course manager except for assignments sent by post. This problem was alleviated by the development of video conferencing technologies. Students could view the course manager on the screen and communicate verbally via a full duplex audio channel. This approach has the problem of requiring locally installed video conferencing equipment to teach.

The internet is the latest means of communication that has been exploited for distance education [2]. With the increased penetration of both PCs and internet access to the work place and home, a flexible method of communicating with a scattered student body is provided. Course materials can be placed online for the students to access at their own pace. This eliminates the need to rely on a potentially slow postal service and student access to course materials is no longer dictated by radio and

television schedules. In addition, assignments can be submitted for automatic correction, given the right tools [3]. The benefit to students is near instantaneous feedback on their performance. Contact between the course managers and students can be maintained through e-mail and discussion forums. While this is not the instantaneous communication of video conferencing it does mean that students can get help in a timely fashion. As internet connection speeds have increased, the need for specific video conferencing equipment is also eliminated as video can be streamed directly to a student's computer [4]. This leads to the concept of a Virtual Learning Environment (VLE), which recreates the educational experience of a traditional environment within a virtual or artificial world usually via a software package. A VLE deployed in a distributed framework can then fulfil the need for a unified application to deliver courses online. With such systems course managers are provided with a content management system, communication components (forums, chat rooms etc.) and components specific to the learning domain such as assessment and grade management.

In 2002, a programme was conceived within the Department of Electronic Engineering in Maynooth to enable technicians with diplomas to obtain full degrees. This programme was entitled Degree Extension for Technicians (DEFT) and would be achieved by adapting the third and fourth year courses used for the department's undergraduate degree. Since this programme was aimed at technicians working in industry, a programme solely based on campus in the university was considered impractical. Members of the department [5] and others [6-8] have reported positive experiences with teaching electronic engineering remotely via the internet. Based on this, it was decided that a distance taught programme would be created and a VLE used to deliver the course content.

A number of commercial / open source options were examined initially. The systems under inspection were Moodle[9], Blackboard[10], Claroline[11], WebCT[12] and Manhattan[13]. Evaluation was carried out against a stakeholder-derived requirements document. All the tested systems fell short in meeting these requirements most notably in the lack of freeform equations and diagram support in interactive quizzes. 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.

The remainder of this paper gives a general overview on how the VLE was developed before

attention is given over to two particularly notable features, the quiz and the results management. A short conclusion with some suggested future work is also given.

II System Development and Key Features

a) *Development overview*

The stakeholder's requirements were gathered in January 2003. The estimated completion date for a VLE fulfilling these requirements was February 2004. This date was six months after the initial DEFT students were expected to register (September 2003). To meet this deadline, only a core set of features was scheduled for completion by August 2003 so that content managers could prepare their courses. Work would then continue to complete the feature set and MyVLE would be periodically updated with new features.

The initial feature set included secure logon, navigation, viewing and editing of courses and content, an electronic drop box for assignment submissions, automatically marked quizzes with the ability to upload batches of questions, grade and results management and finally discussion forums to facilitate class discussions.

To do all of this in the limited time frame available, the Extreme Programming (XP) software development process was used. XP is a development philosophy that has been designed around the idea of producing reliable, bug free code that performs exactly how the customer wants and expects. XP is an example of an agile software development methodology [14]. By using XP, it was possible to build, test and deliver the VLE on time.

LAMP [15] was chosen to be used for the creation of MyVLE as it facilitates the rapid development and deployment of dynamic websites. LAMP is a suite of open source packages commonly used together to run dynamic websites. It comprises Linux as the server operating system, Apache as the web server, MySQL as a database backend and a choice of Perl/PHP/Python as a scripting language. In our case PHP was used. A successful test deployment was created on a Windows machine (also running Apache). More details of the XP experience in this project can be found in [16]. The working MyVLE system is currently running at <http://myvle.eeng.nuim.ie/>.

In the next section we shall focus on two of the more notably innovative developed features, the quiz and results management.

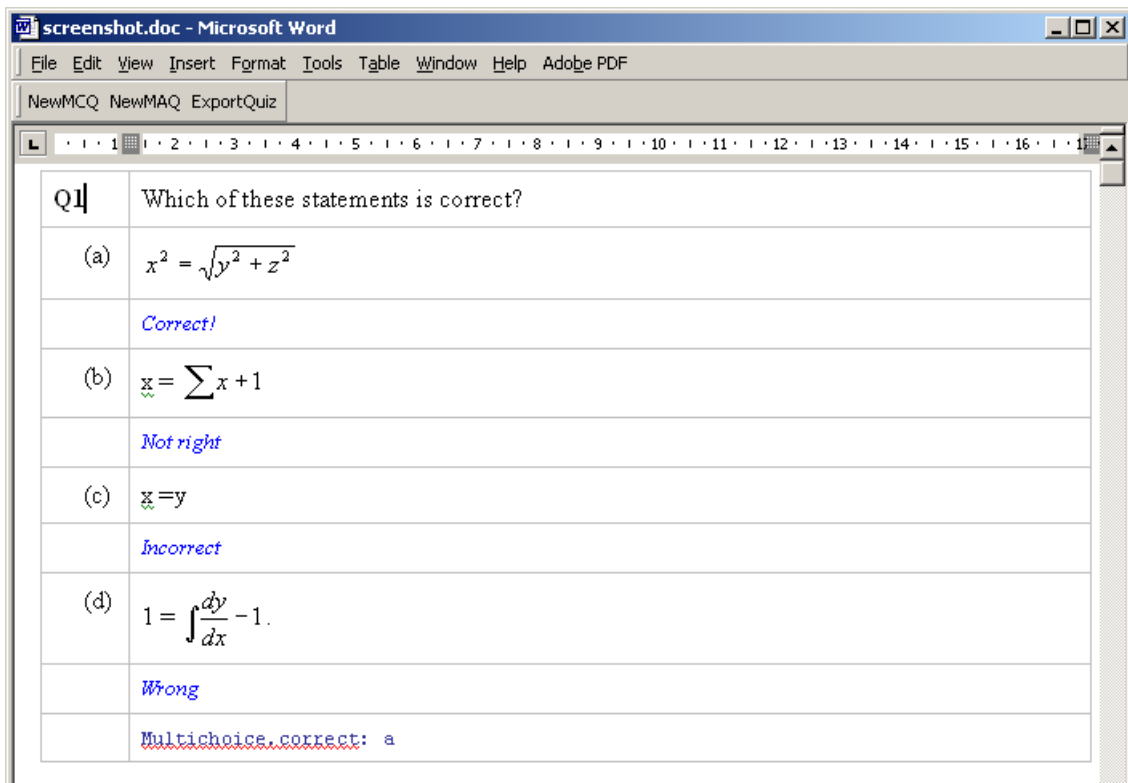


Figure 1: Quiz template in Microsoft Word

b) The Quiz

MyVLE offers two types of quizzes to a content manager. The first is a repeatable, ungraded quiz intend for use by the students to chart their own progress. Then there is a once off class test that would contribute to the student's final grade.

To create either of these quizzes, a content manager usually a lecturer would use a supplied Microsoft Word template, which included some helper macros. This method of creating questions was chosen instead of the common alternatives: a web based form or an XML template. The lack of a 'what you see is what you get' (WYSIWYG) editor for XML meant that test users found it difficult to create questions and answers satisfactorily. With web forms, users found it irritating to have to separately upload any images they wished to use, rather than just being able to insert them. The lack of WYSIWYG equation editor and ability to edit batches of questions at a time also proved limiting.

With the MS Word template, the user could create as many questions as they wished at once. As MS Word is a WYSIWYG editor, images and equations could be placed where ever the user wished and the end result is immediately viewable. The questions can come in two forms, multiple answer and single answer. From two to ten answers could be provided and comments on the answers (usually used to explain why an answer was the wrong choice) could also be provided for the students to view upon completion of a quiz. Figure 1 is an example of a question in this template.

Once the user has finished adding questions to the template, a macro is used to create a single file for upload. A web form allows the user to upload the quiz file and fill out some details, such as a quiz name, number of questions to display to students, length of time allowed (for class tests only) and so on. The quiz file is then interpreted by MyVLE and the questions entered into the database.

To take a quiz, the students enter the quiz page from their MyVLE module home. In the case of a class test, they are informed that they can only complete the quiz once and given an option to cancel. The quiz itself is displayed as a web form. This consists of blocks containing a question followed by the associated answers. To select an answer, the student either selects a radio button (in the case of a single answer) or a checkbox (in the case of multiple answers allowed). Once the student has finished answering questions, they click on the 'submit' button and the quiz is processed. Depending on how the content manager has set up the quiz, the student can their mark, the questions they answered incorrectly and comments on the answers they gave. During the pilot of MyVLE, a course manager experimented with replacing a paper based multiple-choice exam with the class test functionality. The class was made up of 212 students and there was no computer laboratory available on campus to accommodate that many users at once. This resulted in the test being run over multiple sessions rather than the one that the traditional paper test allowed for. While the software worked as expected converting to the electronic format was far

Multiple Programmes

Home >> Results >> An example module (EX101) >> Example Assessment

ASSESSMENT DETAILS

Name: Example Assessment
Average: 0%
Contribution to Module Grade: %

RESULTS

Student	Score	Include Result	Actions	Comment (Optional)
Student One	<input type="text" value="0"/> %	<input checked="" type="checkbox"/>	E-mail student	<input type="text"/>
Student Two	<input type="text" value="0"/> %	<input checked="" type="checkbox"/>	E-mail student	<input type="text"/>

Hide results from students

E-mail [all students](#)
Return to [Results](#) page.

MyVLE 1.0.04 (RC4)
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Figure 2: Form to enter results for an assessment

more resource intensive overall than the equivalent paper based tests, despite the savings gained with instant marking.

c) Results Management

The results management feature was developed to enable course managers to easily manage and store marks from assessments completed offline by the distance students. Rather than having to e-mail each student with their result and store the results separately, the content managers wished to do this in a more efficient manner.

It is a good example of how the constant feedback expected when using XP helps make a better product. Initially, only results for individual students could be entered. After feedback from content managers, this evolved to also being able to enter results for an entire class at once, with a comment box for each result and the ability to omit results. A contribution to the final grade can be specified and the value of this for each assessment made viewable. An example of the page used by a course manager to enter results for an assessment is shown in Figure 2.

Averages based on assessment and overall module results were made available to both the students and the content managers.

A proviso on students viewing class averages is that if there are three or fewer students taking a module, the averages are not made available. This is to stop a student from being able to easily work out the mark given to another student. Results can be hidden from students until the content manager decides to make them public.

The response from students about this feature was overwhelmingly positive. Using the feature, they felt they could easily track their progress across modules. When content managers did not use the result functionality, the students complained bitterly. The result management, thus, provided a feature that we and the other stakeholders found superior to those in competing VLE system.

III Conclusion and future work

The fundamental reason behind the development of MyVLE, enabling the deployment of an Electronic Engineering programme online so it could be taught remotely, was met with success. In the first year of the DEFT programme, 100% of students completed their courses successfully. This compares favourably with the pass rate of 83% for the on campus third years that were taking the same courses. In the second year, 80% of the students passed.

MyVLE does not have the breath of features present in some of the other VLE offerings, but this simplicity works to its advantage. This small feature set was tailored to our user's specific needs. After the initial deployment, additional features were developed based upon user feedback. The complete system has many admirable aspects but it is the quiz feature and results management that we feel are most innovative and useful when compared to existing solutions. While other VLEs (such as Blackboard and Moodle) have the facility to batch upload questions, the initial creation of questions has to be done via web forms. This can be a time consuming process as you can only create questions one at a time and can involve multiple forms. The MyVLE template system avoids this by allowing multiple

questions to be created at once. The template currently only caters for two types of questions and this should be expanded to cater for other question types.

There are many improvements that could be made to the MyVLE quiz feature itself, but the one that presents itself immediately is the ability to import questions from the Blackboard question pool format. There are textbooks that provide Blackboard compatible questions pools (on CD or as a download from a website). It would be desirable if these questions could be imported directly into MyVLE. This would require an expansion of the current quiz functionality to add the extra question types and to correctly interpret the question pools. Other open source VLEs (such as Moodle) have shown that this functionality is feasible. The results management module is currently very usable and stable with no significant changes expected although perhaps enhanced exporting features may be integrated as needs require.

In summary, MyVLE is a distance-learning environment that has been built from the ground up with engineering and science support in mind. As well as streamlining results management it provides comprehensive equation and diagram support in a hitherto neglected domain of VLE content namely the interactive testing components or quiz features. It has been successfully deployed to nearly two thousand students and will provide a basis for future pedagogical research in engineering distance learning.

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