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An Introduction to Virtual Learning Environments

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1. Introduction

In this paper we briefly introduce virtual learning environments, which have become integral to *online learning* (or *e-learning*) in higher education around the world. We describe what they are, the functionality they provide and the kinds of benefits they offer universities, with particular reference to the subject of economics. We also touch on some considerations concerning the e-learning software itself, setting their development in a historical perspective. In our analysis we draw especially on practices in the UK with illustrations from WebLearn, the virtual learning environment used by the University of Oxford.

2. What is a VLE?

A *virtual learning environment* (VLE for short) is a collection of software tools supporting academic administration, teaching and research using the Internet, particularly the World Wide Web¹⁾. As information and communication is increasingly conducted online such systems have become part of the essential educational infrastructure in many higher education establishments. Just as with e-mail, VLEs are centrally provided services that are delivered right across the institution largely to enhance existing academic practices, not to replace them.

Broadly speaking, the functionality can be partitioned into five main areas (following the scheme at Oxford²⁾):

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- 1) There are many similar and related terms, reflecting different purposes and aspects of such systems. These include *learning management system (LMS)*, which is a term that originates in training staff in business, *collaborative learning environment (CLE)*, which emphasize tools to support students in the learning, particularly among students working on joint projects; and *course management system*, though the use of this term may be deprecated because the abbreviation of *CMS* is more commonly interpreted as *content management system*.
- 2) *WebLearn - The University of Oxford VLE: Tools in the New WebLearn*, Oxford University Computing Services

- **Information:** for the distribution of organisational news, notices, documents and other data, such as announcements, regulations, syllabi and schedules;
- **Content:** for making available a wide range of electronic resources in a variety of media, ranging from lecture notes and reading lists, through to video demonstrations and podcasts, plus hyperlinks to external content hosted anywhere on the Internet;
- **Communication:** online tools augmenting face to face contact through facilities such as mailing lists, moderated discussion fora, messaging, and wikis;
- **Assessment:** both formative and summative assessments can be supported in terms of tests, surveys, and assignments. Feedback can be provided using a variety of methods and media, including annotated scripts and video commentaries;
- **Management:** perhaps of greatest overall organisational benefit, VLEs provide management tools operating at different levels. They can support the planning and delivery of courses across departments and schools covering course registration, student monitoring, and the administration of marks. They provide a single point of online entry not only for the pedagogic purposes of teaching and learning, but also for administrative matters such as institutional audits.

The VLE has thus a capacity to provide a central focus for students and staff alike, irrespective of their geographic location, aiding continuity in the teaching and learning processes. Teachers can use the service to help prepare classroom materials, store them safely, and subsequently refine them. VLE systems usually come with scheduling facilities, so that students can download synopses in advance of a lecture, whilst lecture notes and slides may be released after the lecture. They may also be used at any stage to solicit student feedback through survey tools and to collect assignments through online pigeon holes or drop boxes.

VLEs typically provide a set of options that determine who has access to these resources and also at what level (such as reading, commenting, editing and administering). This is a key feature that enables fine-grained control: areas can be made open (to members of the public) or closed, for instance limiting access to a particular group and making materials available only between certain dates. There are in fact many course materials freely available, of which a notable example is MIT Open Courseware, which includes materials in Economics³⁾. However, the value of a good education emerges in how these materials are presented, in the communication between a teacher and a student and the various other kinds of specific support; a VLE's primary role may be considered as contributing to that support.

2.1 An Illustration of a VLE in Practice

We briefly illustrate a VLE in practice by reference to WebLearn, a centrally hosted virtual learning environment that has been running in Oxford since 2003. Its starting point is a home page, which acts as

online documentation <http://www.oucs.ox.ac.uk/weblearn/index.xml.ID=toolslist>

3) *MIT Open Courseware: Economics*

<http://ocw.mit.edu/courses/economics/14-02-principles-of-macroeconomics-fall-2009/>



Figure 1: Home Page for WebLearn, Oxford University's Virtual Learning Environment

a kind of portal to resources across the various departments, as illustrated in Figure 1.

If we examine the layout of this page, we find a number of significant features. The ownership and the purpose of the site are made clear through the University crest and logo, which are placed prominently at the top; and in the adjacent title, accompanied by the listing of the five areas we've just mentioned. To the right are two links for logging in: the main link is for Oxford University members, who use their single sign-on credentials, whilst the other link is for external users such as ad hoc visitors and research collaborators who are not members of the single sign-on system. Once logged in, the system applies access controls to particular parts of the VLE, as befitting the various pedagogic needs described above. In Oxford's case this typically means that a degree cohort may be granted access to course syllabi and lecture notes, whereas only a few may be able to participate in an online forum for a small tutorial group.

Occupying the central space is the main content. This is usually related to some specific academic purpose, but for the entrance page, some general information is provided. In this instance there is a poster advertising a user group, which is aimed primarily at staff, inviting them to learn more about the system and to share their experiences with other academics. A VLE thus provides facilities for general service announcements and promotion of events, adding to the range of broadcast communication methods.

The primary means for accessing departmental areas is by navigation menus that allow traversal of a nested hierarchy, reflecting the institution’s organisational structure. Students and staff proceed by selecting the links shown on the left. In this way, they ‘drill down’ to their respective area and may reach, for instance, resources for a particular tutorial, as shown in Figure 2.

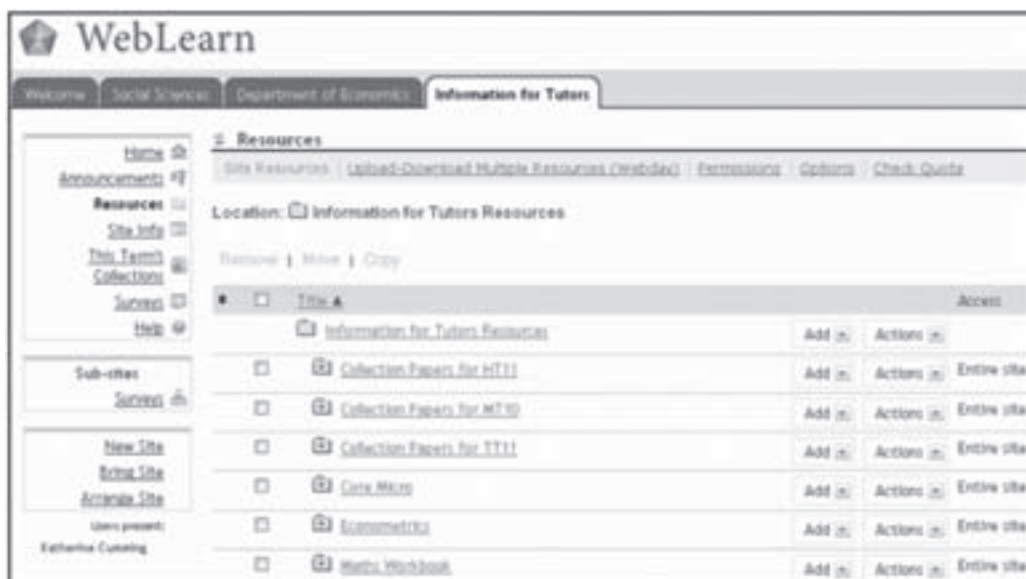


Figure 2: WebLearn File Resources for Tutors in Economics

Each page displayed in a VLE is tailored to the user. In this case, tabs are arranged along the top to show the context: thus we are presently viewing the page ‘Information for Tutors’ within the Department of Economics area, which itself is contained within the Social Sciences Division of Oxford University. Arranged down the left hand side are further pages relating to this one.

This area contains resources, consisting of uploaded electronic materials, which are arranged in a very similar way to how an academic might organise teaching materials on a personal computer. Items are organised into folders and files and named according to topic. However, as indicated in the row labelled ‘site resources’, there are some extra facilities designed to allow such online material to be made available selectively. Through the ‘permissions’ link, staff can restrict access so that specific colleagues can edit the materials whilst students can only view them. Thus the preparation of teaching materials may be conducted conveniently among colleagues, without the need for e-mail, which can become cumbersome, especially when more than several people are involved.

As on one’s personal computer filing system, these files can comprise text-oriented documents, such as word processed syllabi, through to interactive multimedia, which are becoming increasingly common as Internet bandwidth continues to increase. This provides opportunities for delivering engaging teaching

content in a variety of formats so as to appeal to students who habitually interact with the Internet for recreational purposes. An example is given in Figure 3, which is a video screenshot taken from an interactive demonstration of the method of Lagrange Multipliers applied to word problems in business mathematics.

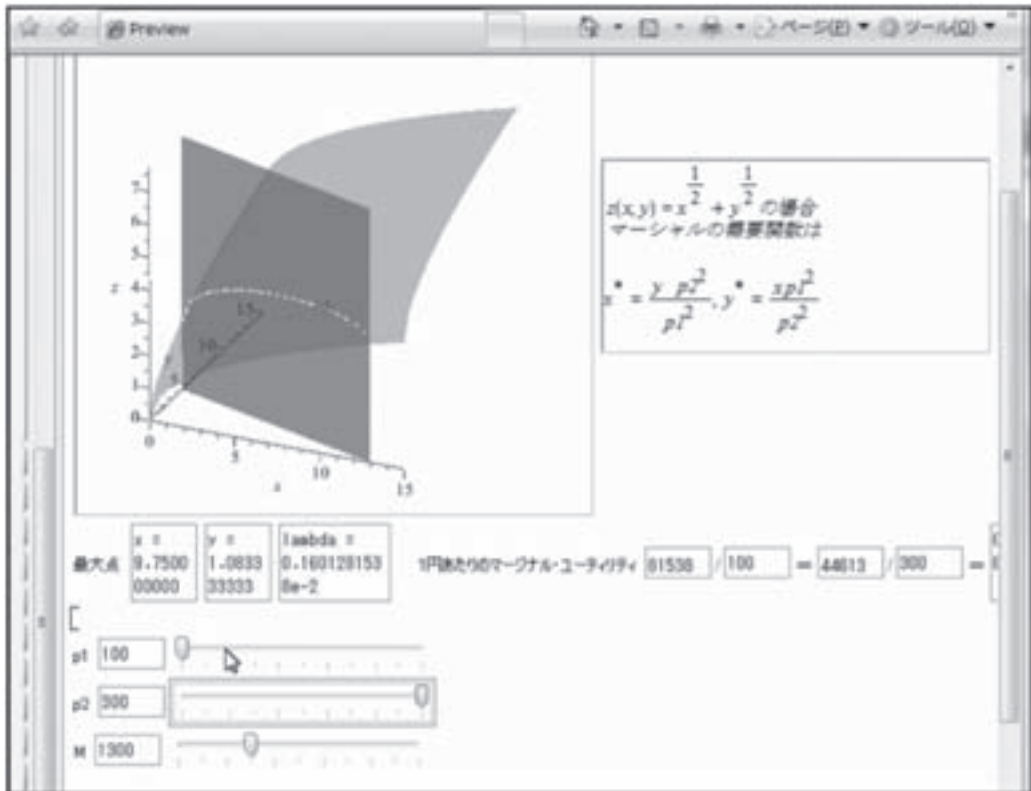


Figure 3: Screenshot of a Web-based demonstration of Lagrange Multipliers

By making available such guidance through the Internet, in a very visual format, the student is encouraged to access and download the material to a laptop or tablet computer, or even to a smartphone and to reflect on the method at their convenience outside the classroom⁴⁾.

There are potential benefits at all stages in the student lifecycle, from preparatory materials to revision exercises. Numerous publications indicate their effective use. In the UK, a primary source of such information for higher education is the Joint Information Systems Committee, which has a Web site with fairly recent research on the effective use of VLEs (JISC 2009). A systematic exploration has been

4) For a recent discussion of systems relating to the teaching of mathematics through e-learning, particularly for visualisations in economics, refer to Shirota *et al* (2011); Trafford and Shirota (2011a,2011b).

conducted in a handbook for Economics lecturers by O'Leary and Ramsden (2002), which provides expanded coverage on many aspects, including an introduction to the reasons for VLE use, and the different levels of usage. Although the research was conducted about 10 years ago, the principles remain largely the same. The handbook also considers how a VLE may be introduced into a department and includes a couple of case studies from UK universities. Overall, the experiences reported were positive – systems were generally easy to use and students appreciated the additional support for face-to-face teaching. One of the authors who contributed a case study, Guglielmo Volpe, has since explored VLEs for student revision: in (Volpe 2005) he presents some quantitative evidence of the benefits of VLE as used for drill practice ahead of examinations in the Business Economics module at London Metropolitan University.

3. VLE Software

Having seen the potential benefits a VLE can offer, the next step is to consider the software options available to deliver these services. If a decision is made to go forward with VLE provision, this will be the core task of any procurement process. VLE software has origins going back many decades to seminal work, such as that by Engelbert (1962), who saw computers as helping in the solution of problems. As the history of their development shows⁵⁾, this presents today a vast array of options and it is not feasible to provide a comprehensive evaluation of them all. So it is important to carefully formulate the essential requirements to establish a firm basis for narrowing down suitable candidates for consideration.

To help delineate the landscape, it may be noted that VLE software has usually been designed to reflect particular contexts, exhibited in two key strands of development. Some systems have been developed initially within universities as small research projects to meet particular teaching needs and have then gradually evolved into larger systems with a suite of tools providing greater functionality. In many cases, such projects have started off with funding from a grant or a public body and then continued as projects in the wider academic community, with the software made available free under an open source license⁶⁾. Examples of such systems include Moodle⁷⁾ and Sakai⁸⁾. On the other hand, a number of products have developed along commercial lines and promoted more widely to include businesses outside the education sector. Such software, developed on a proprietary basis, has often been adopted by higher education institutions looking for the reassurance of robust corporate solutions. Examples include Blackboard⁹⁾ and Desire2Learn¹⁰⁾.

5) The ever changing VLE landscape is amply depicted in a Wikipedia article: *History of virtual learning environments* http://en.wikipedia.org/wiki/History_of_virtual_learning_environments

6) The Open Source Initiative provides a selection of standard OSI-approved licenses, which are used worldwide by individuals and large corporations such as Google. <http://www.opensource.org/>

7) *Moodle.org: open-source community-based tools for learning* <http://moodle.org/>

8) *Sakai project | collaboration and learning – for educators by educators* <http://sakaiproject.org/>

9) *Blackboard Home*. <http://www.blackboard.com/>

10) *Desire2Learn: Innovative Learning Technology by Desire2Learn Incorporated* <http://www.desire2learn.com/>

However, all these systems face a further complicating factor that has emerged in recent years: the growth of online consumer behaviour. Most students who arrive at university have already been using the Internet for several years and in many cases they have become familiar with a wide range of tools for e-mail, Web browsing, office applications, and so forth. Of particular significance is their engagement in *social media* – Web 2.0 software including services such as blogs and social networking sites. So it is increasingly the case that VLE software needs to be adapted to accommodate Web 2.0 approaches.

This background might suggest that e-learning provision is best satisfied through a large collection of disparate tools from a variety of sources. This could deliver e-learning functionality and tailor it very finely, analogous to the way that different packages may be used on a personal computer to handle the various general and specialist applications. However, just as it is convenient for staff and students to come together to share the same physical buildings for a range of designated purposes, so too there are natural advantages in adopting a general purpose system with a suite of tools for shared needs. A single system offers an overall cohesion and consistency in look and feel, with easier administration and maintenance, leading to greater efficiency. Such a system can also encourage more collaboration between departments since a standard platform facilitates the sharing of knowledge and experiences. Furthermore, it is often possible to incorporate or link to additional third party tools by making use of appropriate Web standards and system interfaces, particularly in relation to Web 2.0 and social media. In this context, VLEs operate more as a framework for e-learning.

This discussion may be substantiated with reference to the software used for the WebLearn service at Oxford University. This is currently based on the Sakai platform, whose origins are to be found in its predecessor, CHEF (CompreHensive collaborativE Framework)¹¹⁾, which was developed at the University of Michigan (Knoop *et al* 2002). As an appreciation of Hiroyuki Sakai, a chef who appeared on the Japanese television series ‘Iron Chef’, the next phase of the project was named *Sakai* (Hardin 2005: slides 13 and 14). Previously, Oxford was running a system called Bodington, originally developed at Leeds University. This was chosen as a result of a procurement process in 2001 and 2002 that culminated in narrowing the decision to two products: Bodington and Blackboard. Reflecting on this choice, Stuart Lee, who led the procurement, emphasized Bodington’s flexibility and the freedom it provided through its open source license to control the software development (Lee 2005). However, it was subsequently felt that Sakai offered similar features, but also a much larger international community, and so a transition to Sakai was initiated in 2007, itself facilitated by a collaboration of several universities called Tetra¹²⁾. Since then, Sakai development work has incorporated many of the features that distinguished Bodington, particularly content hierarchy.

The VLE scene is changing rapidly. In particular the scope of the open source systems has been broadening, so that for instance in addition to large deployments at the University of Michigan and

11) CHEF Information site <http://chefproject.org/>

12) Tetra Project <http://www.tetraproject.org/>

Indiana University, smaller private colleges and universities make up the largest number of Sakai implementations¹³⁾, and Moodle, which is well known for being easy to deploy in the context of an individual department, has been well established as the main VLE at the Open University, the largest university in the UK (Sclater 2008). Commercial proprietary systems are also evolving, particularly to embrace more personalisation and inter-operability.

4. Conclusions

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This paper has presented only a basic introduction to virtual learning environments, giving some indication of their potential usage in the context of an economics department. In summary, VLEs offer a vast array of functionality covering academic administration, teaching and research delivered by a wide range of software that has grown according to a broad spectrum of requirements. Deployed widely across the world in higher education institutions, VLEs have become consolidated as a core e-learning service in many universities and this status looks set to continue, though the nature and extent of their use varies considerably.

As digital information continues to permeate educational processes, the potential benefits of adopting an institutional VLE are increasing. Software systems cannot substitute for educators, but they can remove some of the tedium for lecturers and augment the teaching resources available to the student. Given appropriate planning and preparation, virtual learning environments can contribute towards a more creative and productive educational experience.

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