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Engagement with virtual learning environments: a case study across faculties

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Abstract

The Virtual Learning Environment (VLE) at the University of Hertfordshire (UH) not only supports institutional and national strategies in learning and teaching, but represents a significant investment in capital. Studies show that VLEs offer a variety of pedagogical benefits and usage of such systems can be effectively measured through the analysis of a system's log files. However, although the increase in engagement with the VLE at UH as a whole has been considerable over recent years, there appears to be a wide variation in engagement across faculties, suggesting that tutors of some faculties could benefit from increased support to improve engagement. For example, during each of the academic years under study, the range of student engagement between two particular faculties differed by at least 290%. Having identified faculties that show consistently low VLE engagement, we need to ask why this is, and ask whether there needs to be further investigation into the reasons behind this disparity.

Introduction

A Virtual Learning Environment (VLE) is defined as a piece of software accessible via a web browser which provides an integrated online learning environment, and which can be used to support flexible and distance learning. (JISC, 2010). A VLE is often a component of a wider Managed Learning Environment (MLE), defined as including the whole range of information systems and processes of an institution (JISC, 2010). The software in place at the University of Hertfordshire (UH) is a bespoke system branded as 'StudyNet' and was first implemented in 2000. Although StudyNet is strictly a MLE, this paper focuses purely on the VLE component of the system. StudyNet is available on and off campus 24 hours a day 365 days a year and is widely used by staff and students and usage statistics are gathered automatically into log files on a daily basis.

VLE benefits

A number of studies have shown that VLEs enhance student learning. According to a survey of over 17,000 students at sixty-three US universities, the benefits of integrating such technology include improved learning, convenience of accessing resources, and easier communication between students and tutor (Educause, 2005). Another study at Coventry University found that the use of a VLE improved face-to-face learning, as students were able to spend more time listening and thinking instead of purely capturing content (Brown, 2003). Brown also found that providing material online facilitates more equal learning opportunities for students with special needs, as they are able to adapt the materials to the format that suits them. In addition, the Higher Education Academy notes that VLEs can improve access to resources for disabled students while helping with the broader challenges of increased student numbers and widening participation, (Chin, 2009).

In a similar study, a survey of over 18,000 US students carried out by Educause (2005) suggested that a VLE enables students to "learn more and faster" by rationalising the administrative functions of courses and by streamlining communications, thereby freeing up more time to "focus upon learning-related tasks". The survey also found that students who reported positive experiences with a VLE found that the use of technology significantly improved their interest in the subject matter and their understanding of complex concepts. Interestingly, the features valued most highly by the students surveyed were the ability to track assignment grades and the ability to access online quizzes and sample exams.

Additionally, a report (available at http://tinyurl.com/3943mdv) by the Joint information Systems Committee (JISC) shows how VLEs can be used to support the Seven Principles of Good Practice in Higher Education proposed by Chickering and Gamson (1985). For example, their first principle is the encouragement of student to staff contact and a VLE can assist in this by allowing students to post messages to tutors at a time and place convenient to them (perhaps through the use of discussion boards). The second principle relates to the encouragement of co-operation between students, and VLEs allow this by providing tools such as private work areas where students can work together on a shared presentation, for example.

In addition, the UK Quality Assurance Agency found that 'the introduction of VLEs has led to considerable enhancements in learning and teaching' (QAA 2009: a), and specifically at the University of Hertfordshire the QAA found that StudyNet is 'so important to students that they feel it underpins the culture of their learning experience' (QAA 2009: b). Others have suggested that by allowing better collaboration and communication between students and tutors a VLE offers significant benefits to students on placements or taking part in work-based learning (JISC, 2006). In addition, with an expected increase in courses delivered through distance-learning, VLEs are becoming more important as 'the distinction between distance and local education is disappearing' (Howell, 2003).

Measuring VLE activity

Important work has been carried out into different ways of studying the usage of VLEs. Some academics believe there are particular challenges in trying to accurately measure VLE engagement. Avouris *et al.,* (2004) argue that it is not possible to build a thorough view of online learning activity by merely collecting data from machine generated log files, and that specialist software should be used instead to carry out this task. Furthermore, Garrison and Anderson (2003) suggest that many of the measurements involved in data mining techniques, such as quantitative content analysis and the relationship between individual discussion board messages are too labour intensive. Although a rough tool for measuring engagement could be provided in the form of measuring the quantity of messages posted by students on a discussion board, they go on to suggest that 'a more pedagogically sound assessment of student participation would result [instead] from a qualitative assessment'. However, Brook (2007) carried out a study of log files at three UK universities (the University of Huddersfield, Leeds Metropolitan University and the University of Central Lancashire) and reported that quantitative evidence of user ac-

tivity does broadly corroborate with qualitative evaluations, and thus meaningful conclusions can indeed be drawn by interrogating web log files in this way.

Engagement variation

In evaluating usage of VLEs however, a number of studies have shown that some universities report wide variations in the levels of engagement across faculties. A large study in the US for example found that students of engineering, business and life sciences prefer more technology in courses than those of other subjects (Educause, 2005). A small study at Kingston University in the UK reported that although students prefer "learning that can be done at home and fitted around social obligations, … some faculties resist integration with VLEs often due to a perception of increased workload". It was also noted that the extent of staff usage of VLEs significantly determined the extent of student use (Heaton-Shrestha *et al.*, 2007).

Another study, carried out at an urban university in the mid-western United States argued that lack of training amongst faculty staff was a barrier to engagement, and that those who are less comfortable with using technology are less likely to use a VLE as part of their course (Reed-Osika *et al.*, 2009). Research conducted by Maclean (2005) at the Pennsylvania College of Education suggests that some faculties emphasise too much on how to "work" the technology instead of successfully integrating the technology into their courses, while a study by Wiesenmayer *et al.* (2008) of over five hundred students across thirty classes at West Virginia University suggests there is no relationship between the amount of technical support and pedagogical guidance and student satisfaction in online courses.

 University of Hertfordshire's VLE

Specifically at UH, one of the key aims within the institutional strategy is to invest in learning technology (http://www.herts.ac.uk/fms/documents/about-uh/uh_strategic-plan_2010-15.pdf). It is clearly important therefore to measure how successfully this aim is being fulfilled, and how consistently and fairly our students are being supported through this aim. This may allow tutors and technical staff to plan learning resources in a more efficient way, ensuring that all students are evenly offered the pedagogical benefits of using a VLE. The purpose of this paper therefore is to ask whether we can learn about the online behaviour of students through the analysis of web usage log files and find any disparity in elearning engagement across the institution with a view to identifying faculties who may need increased support.

The University of Hertfordshire's institutional strategy recommends improving flexible working and investing in learning technology and a report commissioned by the UK government into Higher Education (Dearing, 1997) identified the scope for information technology to improve the quality and flexibility of higher education. It is clear that the usage of StudyNet at UH supports these initiatives, and it is important to ensure not only that students' elearning is supported evenly across the institution, but that the university's capital investment is exploited fully.

All students are given StudyNet accounts upon enrolment and generally use the system in two ways. Firstly, to access general university information (for example university news, careers advice and general learning resources), and secondly to access specific areas dedicated to a particular module. These areas, known as 'module sites' are populated by the uploading of teaching resources by tutors and essentially form the VLE component of the system. These module sites provide access to resources such as documents, presentations, online quizzes and media clips but also offer collaborative activities such as discussion forums and wikis.

Shown below is a typical screenshot of StudyNet, showing an example of a selection of teaching resources in the centre of the screen. The top part of the screen presents two menus in the form of a banner which is present in all areas that a student would navigate, while the left hand area of the screen represents options available within this specific module.

Figure 1. *A sample module within the VLE, showing teaching resources.*

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Methodology

As a Managed Learning Environment, StudyNet acts not only as a fully functioning VLE but also serves other purposes supporting the administrative functions of the University. It is therefore important, when considering usage patterns, to distinguish between these two areas of the system where possible. StudyNet is hosted on-site at UH and the servers which host the system create daily logs of the system usage. The learning environment component of the system is subdivided by course module, such that each module is represented by a 'site' within the system. It is important to note that some course modules do not have a presence in StudyNet, as it is left up to the discretion of individual module tutors whether a site should be set up for their course.

Types of activity

In this study, two different types of user activity are considered; 'module-read' and a page request. For the purposes of this paper, a 'module-read' occurs when a student loads any page from a part of the system specifically relating to a module, known as a 'module site'. A page request is defined as the action of a user loading a web page into their browser (Ince, 2001), and is a unit frequently used in estimating web server traffic and gauging the popularity of web sites. In this paper a page request represents any user visiting any part of the system. Page requests are considered here in order to provide a background against which the module-read figures may appear more meaningful. It also helps us to understand any background patterns that may emerge over the years in question.

In measuring usage of the system, page requests are considered from both staff and students, but module-reads were measured from students only. This is a better measure of the extent to which a module site is being used because tutors themselves naturally generate traffic simply in the process of setting up teaching resources. A module site heavily used by a tutor but infrequently visited by students clearly should not contribute to a measure of student engagement of the system.

A module site has the ability to store many different types of teaching resource, not only documents and presentations, but other types of resource such as media clips and quizzes and areas such as wikis and discussion boards, where students can communicate amongst themselves and with the tutor.

Information recorded in the server's web logs includes the user's unique identifier (from which the faculty and other information can be derived, including the distinction between staff and student), the date and time of access, the amount of data transferred, the Uniform Resource Locator (URL) of the resource accessed and an identifier relating to the student's connection to the internet at that time, known as the 'host'.

Because of the structure of the system, it is possible to interrogate a URL that a user has visited and determine whether a page request relates to the part of the system relating to

a module (in other words the VLE component of the system) or to some part of the system representing the university's administrative functions. Because module sites are all held within the directory titled 'crs', a page request containing this identifier represents a page request on an element of the system dedicated to a particular module, that is, a 'module-read' occurs.

For page requests, usage figures were recorded across all faculties between the academic years 2003-04 and 2008-09 inclusive

For module-reads, usage data (gathered purely for students), spans the smaller range of academic years from 2004-05 through to 2007-2008 inclusive, and for the six academic faculties at UH. (No faculty data was available for 2008-09 and prior to 2006-07 a different faculty structure was in place, making comparisons over time difficult).

Between the academic years 2004-05 and 2007-08 there were six faculties at UH, which for the purposes of this paper have been anonymised and are referred to by alphabetic identifiers A to F. In order to find patterns of usage across faculties, the following data were considered:

1) The total number of students in each faculty
2) The number of module-reads by students for each faculty
3) The hourly and weekday distribution of page requests
4) A comparison between usage of the system specific to module sites and other areas.
5) Distinct hosts served
6) Volume of data transferred

In an attempt to measure a given faculty's relative engagement with the VLE a 'usage index' is calculated. This is defined as a given faculty's proportion of module-reads divided by the faculty's proportion of students in the university. An index greater than one therefore indicates a faculty's engagement is higher compared to other faculties.

Thus,

Usage index =

$$\frac{\text{(Faculty module-reads/total module-reads)}}{\text{(Faculty students/total students)}}$$

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Results

The tables and graphs below show how the scale of VLE engagement has changed over the academic years under study, and how the level of engagement is divided amongst faculties. Graphs showing the changes in hourly and weekday distribution of usage are also shown, to provide additional context (Figures 1 and 2).

Table 1. *Total number of students in each faculty for the academic years between 2004-2005 and 2007-2008. These totals are used in calculating the Usage Index described earlier.*

Faculty	2004/5	2005/06	2006/07	2007/08
Faculty A	3850	4030	3970	3880
Faculty B	1420	1970	2080	2100
Faculty C	3800	3370	3260	3080
Faculty D	7380	7810	7760	7360
Faculty E	3220	3490	3380	3290
Faculty F	1620	1540	1680	1460
Total	21290	22210	22130	21770

Table 2. *Module-reads (in millions) by faculty between the academic years 2004/05 and 2007/08. According to this measure, each faculty has increased its engagement during the years for which figures were available.*

Faculty	2004/05	2005/06	2006/07	2007/08
Faculty A	8.43	11.70	12.91	11.19
Faculty B	0.40	1.13	1.46	1.81
Faculty C	8.66	9.91	10.62	10.51
Faculty D	8.70	12.22	14.59	15.11
Faculty E	4.57	6.27	7.31	6.48
Faculty F	3.26	4.53	4.93	4.50

Table 3. *Usage Index by Faculty for the academic years 2004-05 to 2007-08 inclusive. The figures show that the engagement between Faculties C and B differ consistently across the years, by at least 290%.*

Faculty	2004/05	2005/06	2006/07	2007/08
Faculty A	1.37	1.41	1.39	1.23
Faculty B	0.17	0.28	0.30	0.37
Faculty C	1.43	1.43	1.39	1.46
Faculty D	0.74	0.76	0.80	0.88
Faculty E	0.89	0.87	0.92	0.84
Faculty F	1.26	1.43	1.25	1.31

Table 4 below shows over a nine-fold increase in the amount of data transferred across the system over the six academic years where figures were available. In addition, the figures show a steady increase in the proportion of page requests taking place on module sites (the VLE component of the system) and that the number of unique machines accessing the system has more than doubled over the same six academic years.

Table 4. *Volume of data transferred, proportion of requests on module sites and unique hosts served between 2003-04 and 2008-09.*

Academic year	Total data transferred (Terabytes)	Percentage page requests on module sites	Unique hosts served
2003-04	1.46	78.1%	338,287
2004-05	2.5	79.9%	425,006
2005-06	3.05	79.1%	757,997
2006-07	5.42	83.5%	749,089
2007-08	6.48	89.9%	750,172
2008-09	13.83	87.4%	826,646

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Discussion

The units of VLE usage used here have been page requests and module-reads, as outlined above. These are both clearly blunt tools in the field of web analytics and of course do not measure the quality of engagement that each student has with the system. What is clear from the data presented in this paper though is that there has been a significant increase in the volume of data transferred between users' computers and StudyNet over the period of observation. Table 4 shows that the volume of data transferred during the years in question rose from under two Terabytes to nearly fourteen Terabytes. Also, the number of distinct hosts has more than doubled over this period, possibly suggesting that StudyNet usage is occurring from a wider range of computers at different locations and less at fixed locations such as UH's own campus. The same table shows that the proportion of page requests occurring in module-specific areas of the system remained steady in the range of 80% to 90%, (from which we can conclude inversely that page requests for areas relating to administrative functions ranged between 10% and 20%). It is important to note however that not all online learning activity within StudyNet occurs on the module sites and not all page requests outside of modules relate to administrative functions. For example, students' blogs are located away from module-specific areas of StudyNet, and yet form an important part of reflective learning for students who use them.

Figure 1 shows the hourly distribution of page requests for the period between the academic years 2003/04 and 2008/09 and shows a significant shift of usage away from normal daytime working hours. However, some of this shift could be due to an increasing number of students connecting from overseas locations with different time zones. Meanwhile Figure 2, which shows the weekday distribution of page requests for the same two years, suggests that students are using StudyNet proportionately more at weekends. Taken together, it could be argued that the two charts show that students are increasingly taking advantage of the 'anytime, any place' nature of using an MLE.

Regarding faculty usage, there are wide differences in module-reads across faculties, but of course there are also wide differences in the number of students at each faculty, which is why Table 3 attempts to strip out this factor by calculating the 'usage index' for each faculty, as defined earlier in this paper. For example, an index greater than one suggests that for a given faculty the students are using the StudyNet module sites proportionately more than students in the university as a whole, while an index of less than one would show less than average usage for a faculty's students. This table shows that usage students at the Faculty C has been consistently high compared to the university as a whole, while usage from students in Faculty B has been consistently lower in comparison. At its narrowest range (2007/08), Faculty C has a usage index nearly four times that of Faculty B, and at its largest range (2004/05) the respective indices differ by a factor of over eight.
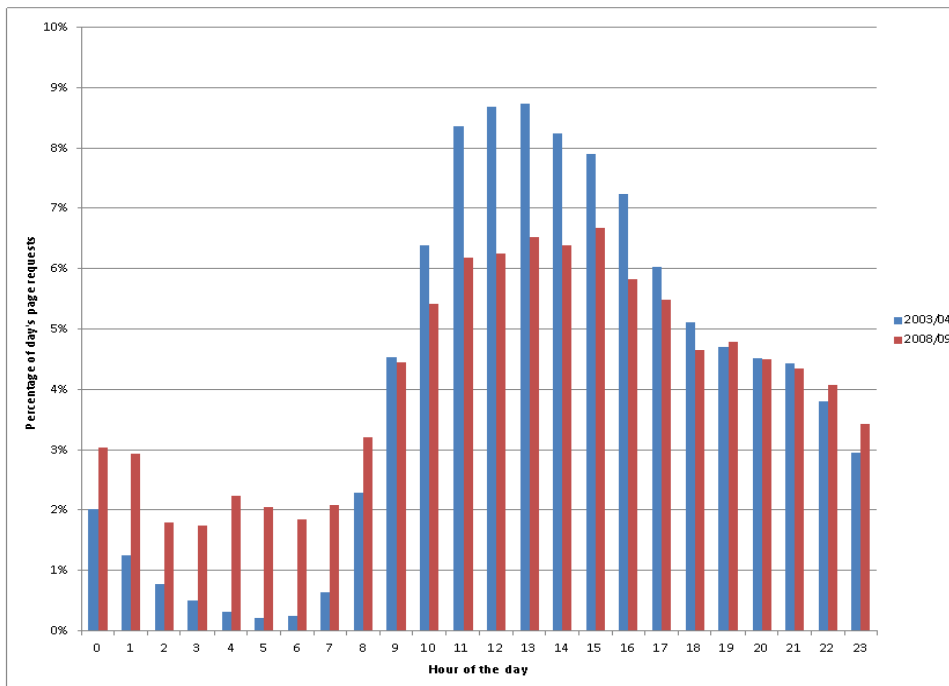
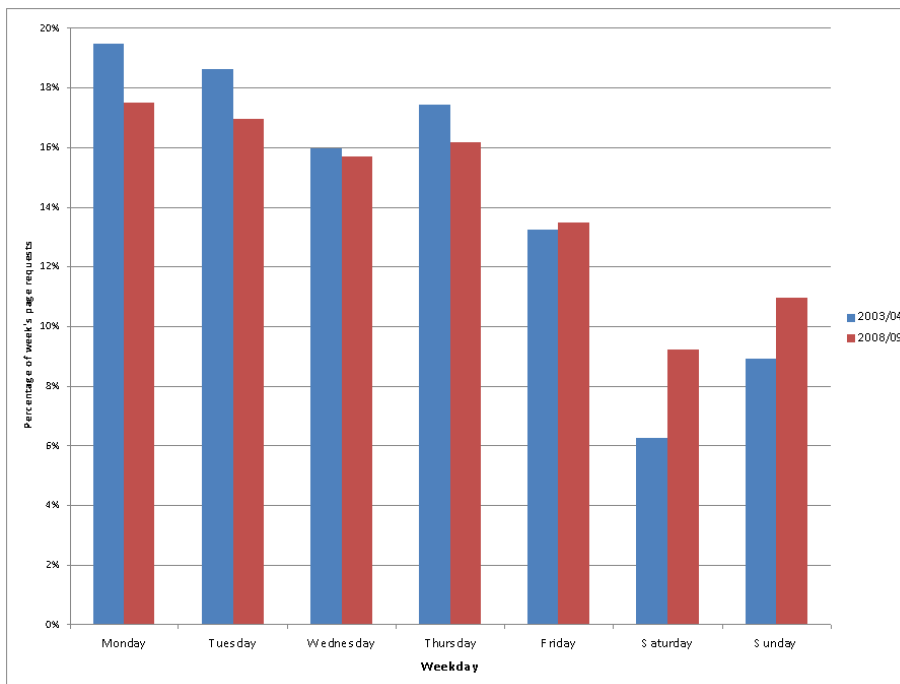Figure 1. *Hourly distribution of StudyNet page requests 2003-04 and 2008-09.*

Figure 2. *Weekday distribution of Studynet page requests: 2003/04 and 2008/09*

Informal feedback from tutors during StudyNet training sessions suggests there may be a number of factors contributing to this effect. As noted earlier in this paper, some studies cite a perceived lack of training and technical support as the cause, while others cite a perception that the preparation time for online materials is excessive. In addition, a study carried out in the United States suggests there is a strong correlation between a student's subject and their preference for integrating technology into their course, with Engineering, Life Sciences and Business favouring the integration of technology significantly more than Humanities students (Educause, 2005). A separate study at De Montfort University in the UK however looked at the impact of a VLE use specifically on students studying a design course, and found that the students viewed elearning positively and did not need additional motivation to use the technology (Brown *et al.,* 2000). The same study though showed that for practical tutorials (a significant feature of the design courses) the preparation time for elearning resources was high, with a ratio of preparation–time to study-time reaching as high as fifteen. Another study carried out at Nottingham University in the UK (Rolfe *et al.*, 2008) also found resistance within arts-based subjects. Specifically, staff in this area felt that "their academic subjects required deeper levels of analysis and discussion that elearning could not provide". The study went on to suggest that this may reflect a lack of understanding of the tools that are available within a VLE, and that any fears that a VLE simply 'spoon-feeds' students could be alleviated by raising tutors' awareness of collaborative tools such as discussion forums and wikis. In addition, a study carried out by Malins and Pirie (2003) suggested that in order to be effective in Art and Design courses, a VLE must complement a pedagogical approach that includes 'experiential, problem based, project based, student centred and team based learning'. More generally, Newton (2002) refers to a number of factors which inhibit the adoption of technology in Higher Education, the most important of which being inadequate infrastructure for access, support and training and a lack of planning at departmental or institutional levels.

Conclusions

As outlined above, measuring MLE usage by means of page requests and module-reads has its limitations, and worthwhile research could be carried out using more refined methods with better tools. For example, Google Analytics is successfully used at Open University, allowing much finer detail to be measured in their VLE usage. In addition, data mining techniques could be employed to examine the possible relationships between users' interaction with StudyNet, such as those that have been carried out by Izso and Toth (2008).

Although the methods may have been simple, a consistently wide variation in MLE usage was observed between different faculties over the years under study at UH. It is possible that some tutors in some faculties are unaware of the pedagogical benefits that such a system offers. Attendance of in-house StudyNet training sessions are optional for tutors, and reflecting on training sessions I have carried out leads me to believe that those who are already motivated to use the system are more likely to attend these sessions. There is clearly a division along faculty lines in VLE engagement at UH, and in order to support students more evenly we need to reach out to those faculties where engagement is low,

and an investigation into the reasons for this disparity is a priority for further research.

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