# Patterns of students' use of networked learning technologies

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## Abstract
There has been increasing rhetoric in the last few years about the impact of new technologies in education and how the ways in which students are learning is fundamentally changing. This paper reports on an empirical study, which provides evidence of the ways in which students are using technologies to support their learning and their expectations and actual experience of the learning environment they are provided with. The picture emerges of a student body that is now immersed in a technology-enhanced learning environment, where learners are appropriating and personalization a mix of personal and institutional tools for their own individual needs. The paper contextualizes these findings in a wider body of related studies, which are revealing similar patterns of behaviour. The paper concentrates in particular on the findings from the online survey, which was part of the data collection process for the project. Details on the findings from the accompanying in-depth case studies (via interviews and audio logs) is reported elsewhere.

## Introduction

The paper describes the findings from a study of students' use and experience of technologies undertaken as part of the JISC learner experience programme (http://www.jisc.ac.uk/elp_learneroutcomes.html). A series of in-depth case studies were carried out across four subject disciplines, with data collected via survey, audio logs and interviews. The paper will concentrate on the survey data, which consisted of a mixture of qualitative and quantitative results. It will compare these findings with related international surveys on students' use of technologies and argue that taken together this wider body of evidence indicates that students are immersed in a rich, technology-enhanced learning environment and that they select and appropriate technologies to their own personal learning needs.

The research focused on two main questions: How do learners engage with and experience e-learning (perceptions, use and strategies) and how does e-learning relate to and contribute to the whole learning experience? We delibarately used a broad definition of e-learning 'the use of any kind of internet or communication service or electronic device that supports … a learning activity', to cover a wide range of technologies. To ensure a wide range of student experiences data was collected with the support of four HE Academy subject centres:[1] Medicine, Dentistry and Veterinary Medicine, Economics, Information and Computer Sciences, and Languages, Linguistics and Area Studies. The participating institutions provided a range of contexts across the UK – old and new institutions, city and regionally based.

[1] http://heacademy.ac.uk

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## Method

The project adopted a methodology developed during a scoping study carried out by Sharpe et al. (2005), to collect data on learner experiences with e-learning. The selection of learners was done in close collaboration with the participating subject centres. Learners who have been effective in their participation with e-learning were approached to capture their experience with e-learning. The methodological approach consisted of two phases – a wider contextual review of the use of technologies across a broad spectrum of students using an online survey[2] and a more in-depth series of individual case studies of technology use gathered through student audio log diaries and interviews. Data collection consisted of three main sources: information derived from the online survey, data gathered through audio logs and transcripts from the interviews. Table 1 gives the breakdown of the data collected.

| **Survey** | | **Case studies** | | | |
|---|---|---|---|---|---|
| | | **Audio logs** | | **Interviews** | |
| Economics: | 128 | Economics: | 3 | Economics: | 2 |
| Languages: | 92 | Languages: | 47 | Languages: | 3 |
| Medicine: | 31 | Medicine: | 16 | Medicine: | 5 |
| Computing: | 158 | Computing: | 19 | Computing: | 4 |
| Other: | 18 | | | | |
| Total | 427 | | 85 | | 14 |

Table 1 Breakdown of data collected

The online survey, which is the main focus of this paper, was used to gain a wider understanding of learners' experiences around particular artefacts, whereas the case studies of individual learners (via the audio logs and interviews) included describing the nature of the e-learning activities carried out by the learner and exploring the e-learner context and background.

## Results

First a broad descriptive analysis was carried out across all the available data to see if some general patterns emerge (see Conole et al., 2006). These patterns were then further analysed to see if there are differences between the participating subject centres and student learning activities in particular. In general the LXP study showed that students are using a plethora of technological tools to support their learning activities. In the survey we asked students about the use of a broad range of technologies in relation to specific learning activities. The activities ranged from communicating with friends, gathering information, to revising for an exam. In this paper we would like to present a selection of the most important findings on how the students used/favour particular e-learning tools for certain learning activities.

The first category we examined was using tools for communication with teachers and fellow students. Email is popular amongst the students and is used 'a lot' across the subject centres to communicate with teachers and fellow students. Figure 1 below presents the spread of using email between the various subject centres included in our study.

[2] http://www.geodata.soton.ac.uk/eLRC/learner_survey/


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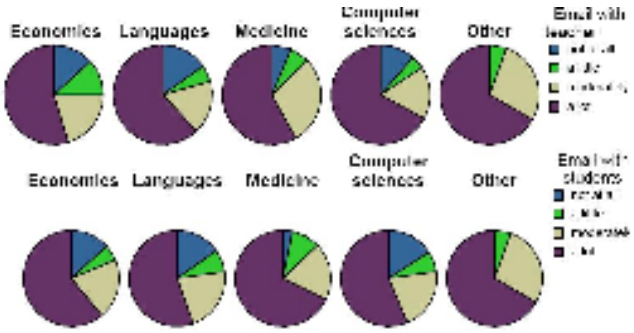

Figure 1. Using email to communicate with teachers and students

However email is not the only tool used. Table 2 below shows that in addition to email, the use of mobile phones and instant messaging (IM) are predominant communication tools. The table also gives a breakdown of use across different locations of study.

| | | | | Number of students working from: | | | |
|---|---|---|---|---|---|---|---|
| Communicating with: | N | Sum | Percentage | Home | Campus | Halls | Workplace |
| Teachers email | 427 | 376 | 88 | 315 | 308 | 78 | 61 |
| Students email | 427 | 370 | 87 | 309 | 307 | 78 | 61 |
| Students mobile | 427 | 330 | 77 | 274 | 281 | 75 | 50 |
| Students IM | 426 | 278 | 65 | 229 | 236 | 72 | 30 |
| Teachers VLE | 427 | 109 | 26 | 88 | 90 | 25 | 20 |
| Students VLE | 427 | 95 | 22 | 81 | 76 | 17 | 20 |
| Students blog | 425 | 69 | 16 | 57 | 56 | 21 | 12 |
| Students skype | 427 | 62 | 15 | 48 | 48 | 16 | 9 |
| Students chat | 427 | 47 | 11 | 41 | 31 | 9 | 7 |
| Teachers blog | 427 | 31 | 7 | 25 | 23 | 9 | 4 |
| Teachers IM | 426 | 27 | 6 | 21 | 16 | 8 | 7 |
| Teachers chat | 427 | 22 | 5 | 19 | 14 | 2 | 6 |
| Teachers skype | 427 | 14 | 3 | 12 | 6 | 2 | 3 |

Table 2. Students' use of communication technology and place of study.

It is clear from the table that students are using a wide range of technologies to communicate with each other and with their teachers. Communication with teachers is predominantly done using email, but amongst the students themselves a larger range of tools are used (email, mobile, Instant Messaging (IM).
Students also reported using their institutional VLE (Virtual Learning Environment) as a way to communicate with teachers (and other students), but, in general, VLE's are used considerably less than the generic communication tools already discussed. To some extent students are using blogs, skype, and chat as communication tools however these are mentioned more or less marginally.

The survey also asked the students at which location they would be using these communication tools. These numbers are represented in the second part of this table on the right. It is interesting to see that the students appear to adopt a multifaceted approach to their location of study, oscillating between home, campus, halls and workplace as appropriate for their needs at different times. The high percentage or PC or laptop ownership and the general pervasiveness of Internet access across these different sties makes this flexible study pattern possible.

Table 3 shows the breakdown of the student population per subject centre.

| Percentage | T* email | S* email | S mobile | S IM | T VLE | S VLE | S blog | S skype | S chat | T blog | T IM | T chat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Economics (N=128) | 87 | 87 | 79 | 63 | 27 | 23 | 11 | 11 | 13 | 7 | 2 | 5 |
| Languages (N=92) | 87 | 87 | 81 | 66 | 29 | 24 | 18 | 9 | 13 | 7 | 3 | 3 |
| Medicine (N=31) | 94 | 97 | 87 | 48 | 35 | 39 | 10 | 13 | 3 | 3 | 6 | 3 |
| Computer sciences (N=158) | 89 | 84 | 73 | 72 | 20 | 15 | 22 | 11 | 20 | 9 | 11 | 6 |

Table 3. Breakdown of communication tools per subject centre in percentages. T= Teacher, S= Student

The percentages indicate little variation between the subject centres. Across the subject disciplines similar patterns emerge, with students using a variety of tools to communicate with teachers and fellow students, mixing use of tools matched to their own personal preference of how they want to communicate. This finding shows that higher education students across the board in the UK are becoming increasingly adapted to using communication technology to assist their learning.

The following tables (4-7) are presented to take a closer look into the kind of learning activities students use technology for. General descriptive analysis of the survey (see also Conole et al., 2006) illustrated that students used a range of tools to support their learning: search engines, electronic libraries, email, and general office software all featured strongly, but there was also evidence of a growing use of Web 2.0 tools, such as Wikis and blogs as well. The tables below provide a more detailed analysis of students used in relation to specific learning activities (such as gathering information, reading course material, revising for an exam and writing assignments), as well as providing an indication of where students are mostly using them.

The first learning activity we analysed is gathering information. General descriptive statistics showed that search engines are used extensively to support learning, mostly to work on assignments (Conole, et al., 2006). Figure 2 for example shows the extent to which students across the subject centres use search engines to gather information.

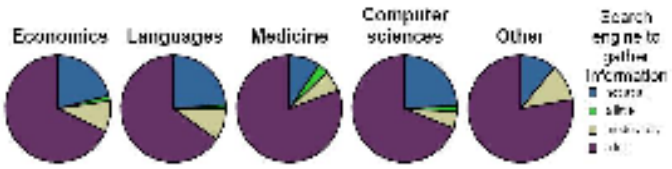


Figure 2. Using search engines to gather information

Further analysis (see table 4 below) about the use of tools to gather course related information shows that search engines are mostly used by students to search and retrieve information. Electronic libraries, which one might expect to rank number one when it comes to gather information in Higher Education, comes in second place with a little over 50% of the students indicating using them. VLEs are mentioned by only 25% of students as a tool for gathering information. This is somewhat surprising given the prevalence of VLEs across the HE sector and the fact that evaluations of the use of VLEs indicates that one of the primary ways in which they are being used is as a content repository (Weller, 2007; Britain and Liber, 2004; Britain, 2005). One might therefore expect that students would use the VLE frequently as a starting point to gather information needed to work on their course assignments. Some other tools are used as well but to a lesser extent, however it shows how students are using a mixture of tools to suit their needs. Email is surprisingly popular as well, which might be used to request for information needed for their tasks, but it can also mean they use email a lot to pass information on to one another.

| Gathering Information | N | Sum | Percentage | Number of students working from: Home | Campus | Halls | Workplace |
|---|---|---|---|---|---|---|---|
| Search engines | 427 | 335 | 78 | 279 | 275 | 78 | 56 |
| Electronic library | 426 | 230 | 54 | 199 | 192 | 46 | 43 |
| Email | 427 | 215 | 50 | 175 | 180 | 36 | 45 |
| Word processing | 427 | 167 | 39 | 139 | 138 | 34 | 37 |
| VLE | 426 | 101 | 24 | 85 | 87 | 25 | 19 |
| IM | 426 | 87 | 20 | 71 | 73 | 21 | 12 |
| Wiki | 427 | 80 | 19 | 62 | 63 | 21 | 13 |
| Blog | 427 | 64 | 15 | 58 | 48 | 15 | 12 |
| Power point | 427 | 58 | 14 | 44 | 47 | 11 | 16 |

Table 4. Using tools to gather information

The second half of the table shows students' location of study, using these tools. Again the most popular places are home and the university campus, but to some extend the workplace features as well as a place where students (continue their) study. This table indicates that students are using different kinds of tools across a range of environments to assist their learning activities. This shows how students nowadays are well connected almost everywhere they are, whether this is at home, university campus (students halls), or at the workplace, and take their work with them accordingly.

| Reading Course Material | N | Sum | Percentage | Number of students working from: Home | Campus | Halls | Workplace |
|---|---|---|---|---|---|---|---|
| Word processing | 427 | 166 | 39 | 136 | 141 | 39 | 30 |
| Electronic library | 426 | 145 | 34 | 128 | 118 | 32 | 27 |
| VLE | 427 | 127 | 30 | 109 | 105 | 27 | 27 |
| Search engines | 427 | 127 | 30 | 105 | 104 | 27 | 26 |
| Email | 427 | 125 | 29 | 99 | 104 | 18 | 22 |
| Power point | 427 | 98 | 23 | 76 | 82 | 24 | 17 |
| IM | 426 | 30 | 7 | 23 | 21 | 8 | 6 |
| Blog | 427 | 30 | 7 | 25 | 24 | 6 | 3 |
| Wiki | 427 | 19 | 4 | 15 | 12 | 2 | 3 |

Table 5. Using tools to read course material

In terms of accessing and reading course material, word processing software is mentioned most frequently, but electronic libraries, VLE's, search engines and email also feature strongly. Again here it seems that students are using a mixture of tools to process the information available to them. At the time of the survey, students appeared to be relying more on 'traditional'/ web 1.0 tools rather then Web 2.0 technologies such as blogs and wiki's; however it is highly likely that there has been a shift towards the latter since the survey was conducted. In comparison to the previous table (see table 4) students are using their workplace less as a place for reading compared to gathering information.

When asked about revising for an exam the students; search engines features most strongly, but word processing, electronic library, VLE and email are also used frequently (see table 6). Figure 3 presents that use of search engines between the subject centres. It seems that they are most frequently used by medicine and computer science students, but the other subject centres are not far behind.

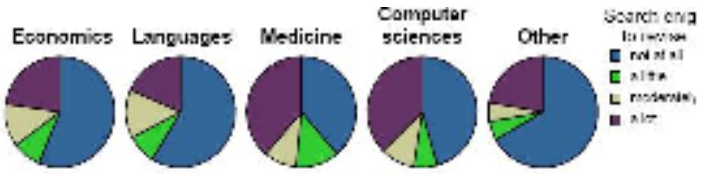

Figure 3. Using search engines to revise for exams

Table 6 further shows that students don't really refer to blogs and Wiki's when revising, but they seem to use instant messaging to some extent to connect with fellow students about exam related issues.

| | | | | Number of students working from: | | | |
|---|---|---|---|---|---|---|---|
| Revise for an Exam | N | Sum | Percentage | Home | Campus | Halls | Workplace |
| Search engines | 427 | 205 | 48 | 169 | 177 | 50 | 32 |
| Word processing | 427 | 168 | 39 | 139 | 140 | 35 | 32 |
| Electronic library | 427 | 143 | 33 | 123 | 123 | 29 | 28 |
| VLE | 427 | 122 | 29 | 99 | 104 | 28 | 23 |
| Email | 427 | 118 | 28 | 98 | 95 | 24 | 25 |
| Power point | 427 | 90 | 21 | 73 | 74 | 14 | 16 |
| IM | 426 | 72 | 17 | 57 | 58 | 26 | 8 |
| Wiki | 427 | 39 | 9 | 30 | 28 | 10 | 6 |
| Blog | 427 | 26 | 6 | 21 | 20 | 7 | 4 |

Table 6. Using tools to revise for an exam

The final learning activity refers to writing course assignments.

| | | | | Number of students working from: | | | |
|---|---|---|---|---|---|---|---|
| Writing an Assignment | N | Sum | Percentage | Home | Campus | Halls | Workplace |
| Word processing | 427 | 299 | 70 | 251 | 247 | 68 | 54 |
| Search engines | 427 | 240 | 56 | 200 | 200 | 54 | 42 |
| Electronic library | 427 | 158 | 37 | 137 | 133 | 35 | 28 |
| Email | 427 | 151 | 35 | 125 | 118 | 35 | 27 |
| VLE | 427 | 92 | 22 | 75 | 76 | 23 | 19 |
| Power point | 427 | 82 | 19 | 65 | 69 | 15 | 12 |
| IM | 426 | 57 | 13 | 45 | 43 | 20 | 9 |
| Wiki | 427 | 33 | 8 | 28 | 22 | 6 | 5 |
| Blog | 427 | 23 | 5 | 17 | 17 | 20 | 4 |

Table 7. Using tools to write an assignment

Not surprisingly word processing is mentioned most as the software of choice for writing course assignments (see figure 4 for a breakdown per subject centre) but this is used in conjunction with search engines, electronic libraries and email. Students work mostly from home or the university campus on their assignments.

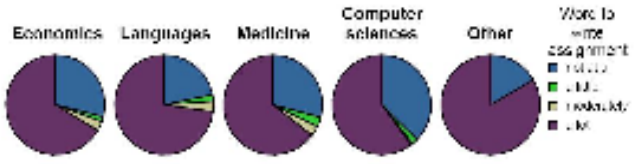

Figure 4. Using word to write course assignments


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## Conclusions and Discussion

The presented findings show that higher education students in the UK from various subject centres are well equipped when it comes to using a wide range of technologies to support their learning activities (computers, laptops, mobile phones, mp3 players, etc.). Besides using the more traditional (dedicated) tools they also seem to find their way to emerging web-based technologies (such as Web 2.0 tools) for communicating, gathering and processing course related information with their teachers as well as fellow students. Students are not only using a wide range of tools they also vary (or seem to be flexible) in where they use them. When asked about their places of study, students indicate studying at home, university campus (including halls of residence) as well as their workplace. This means that students are in general fairly flexible in their use of different technologies as well as mobile in terms of where they are able to use them.

Our findings map to an international trend toward higher levels of PC-ownership, coupled with increased ICT usage and skills (See for example ECAR, 2007; Kennedy et al. 2006). Many are now arguing that these students fundamentally differ from previous generations in the way they process information and communicate (and hence learn). Terms such as: 'digital natives', 'the net generation', 'the Nintendo generation', 'the neomillenial generation' (See for example Oblinger and Oblinger, 2005; Prensky, 2001; Baird and Mercedes (2006)) have been used to try and encapsulate this shift. The characteristics of this new generation include the fact that they are comfortable with technologies and adept at working in multiple/multi-modal environments. The ways that they learn are more task orientated and experiential. These learners prefer to receive information quickly, are adept at processing information and multi-tasking, and using multiple communication channels to access information and communicate with friends and tutors. They seamlessly integrate online resources and desktop applications with paper-based materials. They are critical users – not prepared to take the use of tools at face value but wanting evidence of real use and benefit. The changes also hint at a potential change in the nature of the way they learn; suggesting that they are strategic and experiential in the way they learn, more comfortable with group learning than previous generations.

A number of key factors emerged, which aligned closely with the findings of parallel studies. We found that the students used the web extensively to extend their understanding of concepts and supplement course material. A study by Kennedy et al. (2006) in Australia focused on how students were using technologies to communicate, publish and share information and their findings were in line with ours, namely that there is extensive use of technology by students; they argue that this has considerable implications for institutional policy and practice. Similarly the ECAR survey (2007) indicated that Internet searching was one of students' most important strategies for learning, with 72% listing Internet searching as their preferred means of learning. In our study we also found that Google (see Conole et al., 2006) was their first action when trying to get information and Wikipedia is used extensively. Most find Google easy to use. However, there is some evidence that students do not always find what they want from a search engine and that they do not necessarily have the advanced searching skills needed to perform detailed academic searches. The rapid positioning of Wikipedia as an important authoritative text, despite its relative newness, is an important indicator of the way in which students are now using technologies with peer review and sharing of 'what counts as good' being an important scaffold to help make meaning of a complex and constantly changing information landscape.

Use of communication technologies to support their studies was extensive. Many students reported using mobile phones frequently to phone and text each other, to discuss issues related to their learning, and particularly for assignment queries. They also used instant messaging software, especially for international communications. Email was used universally and was the main channel for tutor communication. A common pattern was for email to be used for communication between staff and students, with text messages and instant messaging used for communication with peers. Students expected and generally received quick responses to their emails and appreciated the flexibility this provided, although this does raise questions about student-tutor expectations in terms of response times. The ECAR survey found that email was still the main communication channel for official university communications.

Only one person on the survey mentioned a VLE as one of the four technologies they like to use most, and ten listed a VLE as a dislike. Critical factors appear to be whether the VLE is well designed and structured, how relevant the information on the VLE is to the students' needs and the degree to which it is really embedded into the culture of the course (see Conole et al., 2006). The findings hint that students are beginning to move beyond VLEs as a central resource and that they use the VLE only when it meets specific, individual needs. Many students did say that they used their VLE to check for course-related information and in some cases the VLE was used as a course calendar or for communicating course administration. A fundamental issue is how students integrate use of the institutional VLE with their own personally acquired technologies. The ECAR survey found "student respondents to be immersed with technology ownership and use, and impatient with instructors who don't have adequate technical skills" (ECAR, 2007: 5). A recent survey undertaken by the SPIRE project supports this, showing a significant increase in the uptake of Web 2.0 technologies by students (SPIRE, 2007). The ECAR survey found that discussion boards were one of the least used features of VLEs; students described them as more time-consuming and less interesting than live discussions (ECAR, 2007: 72).

The findings demonstrate that students use a variety of communication tools to support their learning needs. Also there is evidence from the data that there is a shift in emphasis from passive to more interactive, across all aspects of their learning, which is another characteristic of today's learners. The environment students are working in is complex and multifaceted; technology is at the heart of all aspects of their lives – a key question for institutions is whether institutional infrastructures match students' own rich technology-enhanced environment, and perhaps more importantly, whether courses are designed and delivered with these external influences in mind.

Students appear to place greater value on technologies they have 'discovered' or selected for themselves. Ownership, personalisation and appropriation of technologies are overarching themes that emerge from the data. Personalisation and a sense of control come across as key factors of success in the use of technologies. Importantly, if students did not find the technology or platform provided by the institutions useful they were in a position to by-pass it in favour of their own personalised approach and preferred tools. The findings suggest a shift in the way in which students are working and suggest a rich and complex inter-relationship between individuals and tools. In a recent paper (Conole et al., forthcoming) we described eight factors that emerged from the data in terms of the changing nature of the way students are working and argued that this might form a useful checklist against which institutions might begin to think about and incorporate these findings into policy and practice.

## References


Baird, D.E and Mercedes, A. (2006) Neomilennial user experience design strategies: utilizing social networking media to support 'always on' learning styles. *Journal of educational technology systems*, 34 (1): 5-32.

Britain, S. and Liber, O. (2004), A Framework for the Pedagogical Evaluation of eLearning Environments:

Conole, G., de Laat, M., Darby, J. and Dillon, T. (2006) An in-depth case study of students' experiences of e-learning – how is learning changing? Final report of the JISC-funded LXP Learning Experiences Study project, Southampton: University of Southampton. www.jisc.ac.uk/elp_learneroutcomes.html

Conole, G., de Laat, M., Darby, J. and Dillon, T. (forthcoming) Disruptive technologies, pedagogical innovation: What's new? Findings from an in-depth study of students' use and perception of technology. Paper accepted for *Computers and Education*.

ECAR (2007) The ECAR study of undergraduate students and Information Technology. Educause report, Volume 6. http://connect.educause.edu/library/abstract/TheECARStudyofUnderg/45075

http://www.jisc.ac.uk/media/documents/programmes/digital_repositories/spiresurvey.doc

JISC Report http://www.cetis.ac.uk/members/pedagogy/files/4thMeet_framework/VLEfullReport

Kennedy, G., Krause, K., Gray, K., Judd, T., Bennett, S., Maton, K., Dalgarno, B. and Bishop, A. (2006) Questioning the net generation: A collaborative project in Australian higher education. *Proceedings of the ASCILITE conference*, Sydney, December 2006. http://www.ascilite.org.au/conferences/sydney06/proceeding/pdf_papers/p160.pdf

Liber, O. (2005), Personal Learning Environments – final report, JISC project report, available online at http://www.jisc.ac.uk/media/documents/programmes/elearningframework/plejiscrep_hw_1.pdf
O'Hear, S. (2006) e-learning 2.0 - how Web technologies are shaping education. ReadWriteWeb site. http://www.readwriteweb.com/archives/e-learning_20.php
Oblinger, D.G. and Oblinger, J.L. (2005) *Educating the net generation*. An Educause e-book publication. http://www.educause.edu/ir/library/pdf/pub7101.pdf
Prensky, M. (2001) Digital natives, digital immigrants. *On the Horizon*, 9(5). http://pre2005.flexiblelearning.net.au/projects/resources/Digital_Natives_Digital_Immigrants.pdf
Sharpe et al. (2005),
SPIRE (2007) Results and analysis of the Web 2.0 services survey undertaken by the SPIRE project. Report for the JISC-funded SPIRE project.
Survey
Weller, M. (2007), Virtual Learning Environments - using, choosing and developing your VLE, RoutledgeFalmer