Student use of web based lecture technologies in blended learning: Do these reflect study patterns?

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Recording of lectures and providing web based access to them is becoming mainstream in higher education courses despite the debate about the value of such delivery modes. How students access these materials and use the affordances provided by the various outputs has largely been reported by surveying students and lecturers about their experiences. This study reports on the provision of web based lecture technology to medical students studying in a blended learning space. Log data files over a 2 year period were used to investigate the usage patterns of students and derive greater understanding about how students make use of electronic media. This analysis reveals some of the different ways in which students used the online materials; thus providing some evidence for mapping the effectiveness of blended learning spaces.

Keywords: Online lectures, WBLT, study style, access patterns

Introduction

The advent of new technology and electronic media can give students more control over their learning environments. Web-based lecture technologies (WBLT), designed to digitally record lectures for delivery over the web (Garrison 2001), constitute one method of meeting learners' needs and allows students to access lectures 'on demand' (Young & Asensio 2002). WBLT have had considerable uptake across the higher education sector in the last decade, across many disciplines (Gosper et al 2008; Collie et al 2009). Initially reports on WBLT focused on the technology itself and responses from students and staff. Concerns were then raised about the effects of these 'on demand lectures' on student attendance at face-to-face lectures. Now interest has shifted to how students learn and how best to integrate WBLT into the curriculum to maximize the benefits while minimizing the disadvantages.

There have been many attempts to evaluate the responses of both students and staff to the increased uptake of WBLT (eg. Nieder & Nagy 2002; Buxton et al 2006; Soong et al 2006; Gosper et al 2008). In general these studies took the form of surveys, providing useful reports on the variety of ways in which online lectures were used. Although in rare instances these surveys achieved satisfactory return rates (eg. Nieder & Nagy 2002), the value of these surveys in terms of the extent of use has often been limited by low response rates (eg. Soong et al 2006; Gosper et al 2008). On the whole, however, students' responses have tended to be very positive, while those of staff somewhat equivocal. Staff were found to be more likely to adopt and use WBLT if they could see benefits for themselves in addition to those for students (Chang 2007).

In several cases server log files were used to track access to the video recorded lectures. The collection and analysis of this objective data allowed reporting of actual use of the digitally recorded lectures in the population under investigation, as well as which material, which format and when these were accessed (Parvati et al 2000; Seidel et al 2000; Nieder & Nagy 2002). Despite the concern of staff that students would be less likely to attend lectures as a result of the availability of lectures on demand, this appears not

to be the case. While students may use WBLT to replace a missed class, they primarily used them for revision before examinations (Parvati et al 2000; Collie et al 2009; von Konsky et al 2009). In addition, server log files allowed further exploration of students' usage patterns in relation to other factors such as assessment performance (von Konsky et al 2009).

More recently, the ways in which students have utilized WBLT and the impact this has had on student learning has been explored. The challenge has become how to make use of new technologies in such a way as to be more appropriate from a teaching and learning perspective (Young & Asensio 2002). Of concern is whether students with particular learning styles are disadvantaged; and where delivery has been fully online, whether students are disadvantaged by the absence of the more interactive, social aspects of the face-to-face lecture (Fardon 2003). On the positive side, availability of lectures on demand allows students to revise at their own pace; the flexibility of different modes of delivery offering more options for stimulating deeper approaches to learning (McCrohon et al 2001).

Linking the online materials with other resources and supplementary learning activities can further enrich the learning experience and offers even more options for those with different learning styles (Donnan et al 2004). While video streaming has moved beyond being just a mechanism for delivery and allows some degree of interactivity (by giving the student control over what material, how often and when to view it), further development is needed to fully integrate WBLT with other resources and other media and to develop a 'virtual learning environment' (Young & Asensio 2002).

USydMP

The University of Sydney Medical Program (USydMP) commenced in 1997 as a problem based, blended delivery course which encouraged self-directed learning. The program was developed and is managed via an electronic content management system (Field & Sefton 2004). All the curriculum documents for Years 1 and 2 are online, including information about the problems, related lecture outlines, learning topics, references, supplementary learning materials, and formative assessment questions to provide students with feedback on their progress. Thus the medical students were used to relying on IT for accessing learning materials, communicating and giving feedback (Gordon 2000).

The videotaping of lectures in USydMP began in response to the increasing student numbers placing pressure on timetabling and physical space constraints, as well as the beginnings of student expectations of this level of functionality. Lecture materials were offered online in multiple formats from the beginning of 2005 for Year 1 and Year 2 students. A preliminary evaluation survey after the first year of online lectures indicated positive responses from the students, but staff expressed some concern regarding copyright issues and the potential drop in student attendance at lectures. Response rates, however, were low (25% of a total of the students and 15% of the staff surveyed). While the surveys provided useful information on preferred delivery formats and how the respondents made use of the lectures, they did not indicate the proportion of students and staff accessing the videoed lectures, or the patterns of access. In an effort to provide a more objective measure of how many were using the online lecture materials, we decided to investigate the log files on the use of the online lectures.

Our initial investigation was directed at finding out what the web server log file could tell us about the rates and pattern of usage. Subsequently we realized that these files contained a wealth of additional information, such as the patterns of student access, which could be used to explore approaches to using this resource and provide some insight about how students move between learning spaces in a blended course.

This paper reports on our analyses of student approaches to using online lecture materials over the first two years they were introduced. In addition, we explored log files as a method for uncovering some of the different ways in which students used the online materials; thus providing some evidence for mapping the effectiveness of blended learning spaces.

Methods

Lectures for Year 1 and Year 2 students were recorded at the time of delivery and made available on the website, usually within one week of the lecture. The web server maintained log files that recorded every download of videos, audio and PowerPoint slides from each lecture. A semi-automated method of creating the video materials was used. Having a human operator present during the initial lecture presentation resulted in a higher quality of filming relative to a fully automated capture system. The resulting digital video file was transferred to a processing server which automatically generated a range of

files for use by students, and as an intermediate step for further manual processing. The formats available to students included:

- PowerPoint slides;
- Rich Media (an interactive Flash narrated slideshow with an index and user controls to enable the user to navigate to sections of the recording) (See Figure 1);
- Rich Media Zip (a downloadable version of the Rich Media file for offline use);
- MP3 (audio only);
- Video (High Quality Divx format and Low Quality SWF format, showing the presenter giving the lecture).

All the files were delivered to the students through the USydMP content management system.

Each occasion of use identified an individual staff or student user, date and time of access, the specific lecture, and the format in which the lecture was accessed. The log files were analysed to describe patterns of resource use over 2005 and 2006.

The following data were obtained from the files:

- The number of files viewed and the format in which they were accessed;
- Which students accessed the online lectures for Years 1 and 2;
- The pattern of access over the year, relative to date made available and the assessment tasks;
- The variation and patterns in usage;
- Examples of user profiles.

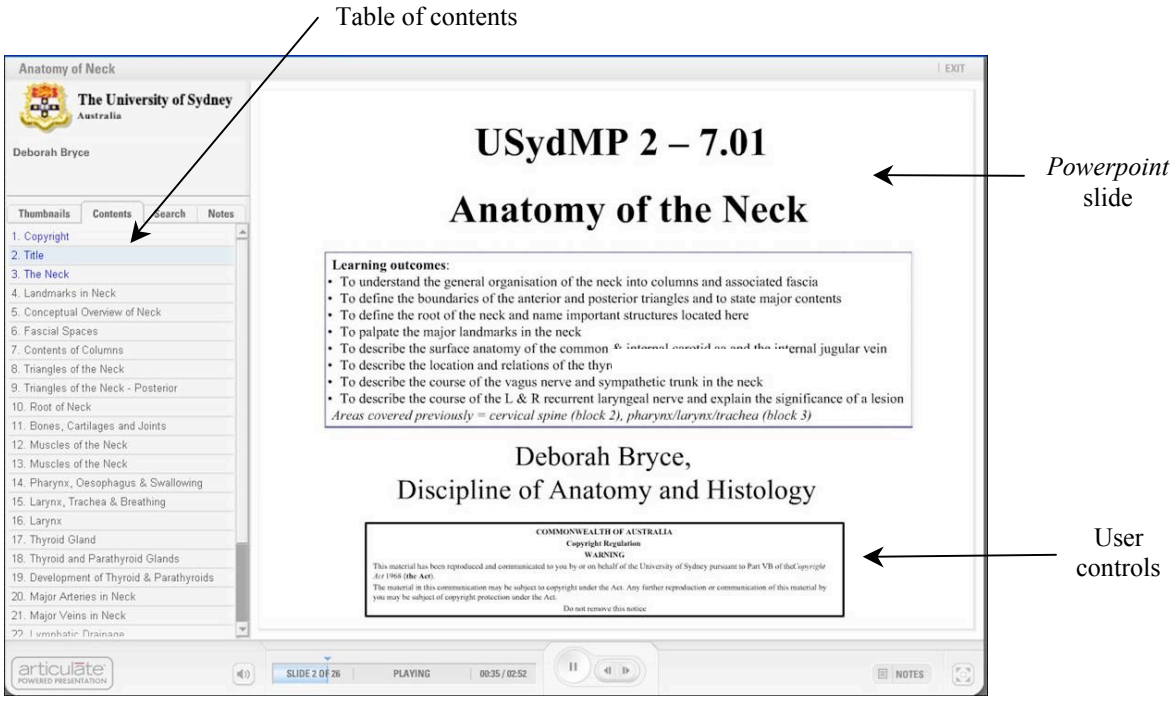


Figure 1: Screen shot of the Rich Media flash file

The sample included all students enrolled in the medical and dental programs (n = 1350) in 2005 and 2006 and all teaching staff of the Faculty of Medicine (approximately 380). As this is the total sample, percentages of students and staff actually accessing these lectures could be calculated, as could the usage patterns. This paper will report use of online lectures by the students only.

The study received ethics approval from the University of Sydney Human Research Ethics Committee.

Results

Log files were available from the beginning of April 2005 until the end of October 2006. There were some missing data during 2005 between 1–30 May, 11–29 June, 4–30 July and 9–31 August, due to a

backup configuration error. Otherwise complete log file records were available until the end of October 2006; new lectures were not recorded after early November each year.

Number of files viewed

A total of 699 lectures were recorded into the various formats over the two years (373 in 2005, and 326 in 2006). Accessing of the online lectures increased dramatically with time, from nearly 33,000 in 2005 to over 120,000 in 2006. The majority of these (around 80%) were made by students (Table 1).

Preferred format

PowerPoint was by far the most preferred format (40%). The next most popular were the Rich Media formats (which synchronise Audio with PowerPoint in their online for zip format) at 22% and MP3 files at 15%. PDF was the next most used with 13%. While video versions were available, these were less often used, although still accounted for nearly 10%; ie. over 10,000 accesses (Table 1). It appears that the Rich Media format was a valuable addition to the suite of options for students, perhaps due to the ability for the user to navigate to the section of the recording required by selecting the slide from the index (see Figure 1).

Which students accessed the online lectures?

We were interested in whether students from years other than their own accessed the lectures. As expected, it was mostly the Year 1 and Year 2 students who made use of the online lectures; in fact almost all the students in these years had accessed them. A small number of Year 3 students also accessed the lectures in 2005, with appreciably more (around half of the year) doing so in 2006. This was possibly to review the lectures that they had attended in the previous year. While none of the Year 4 students accessed the materials in 2005, one third of the year did so in 2006 (Table 1). It should be noted that over half the downloads made in 2006 were of the 2005 lectures.

Table 1: Online lecture access statistics in 2005 and 2006

	2005	2006	Total
Total accesses	32944	120103	
Student accesses	25960 (78.8%)	94355 (78.6%)	
Type of format	25824	88346	
PowerPoint	8641 (33.3%)	38944 (41.3%)	47585 (39.6%)
MP3 Audio	4365 (16.8%)	14281 (15.1%)	18646 (15.5%)
Rich Media - online version - zip version	6877 (26.5%) [3690] [3187]	19599 (20.8%) [14345] [5254]	26476 (22%) [18035] [8441]
PDF	3352 (12.9%)	12777 (13.5%)	16129 (13.4%)
High Quality Video	1710 (6.6%)	6206 (6.6%)	7916 (6.6%)
Low Quality Video	879 (3.4%)	2539 (2.7%)	3418 (2.8%)
Student cohort			
Year 1	268/286 (94%)	280/289 (97%)	
Year 2	222/259 (86%)	263/286 (92%)	
Year 3	19/219 (9%)	134/259 (52%)	
Year 4	0/205 (0%)	75/219 (34%)	
Content			
2005 lectures	25165 (96.9)	52240 (55.4%)	
2006 lectures		37994 (40.3%)	
Help files or other	795 (3.1%)	4112 (4.4%)	

Patterns in usage

The usage patterns across 2005 and 2006 are represented in Table 2. Despite the missing data in 2005, our findings demonstrated a clear increase in use across the year, and between the first and second years the online lectures were available. While the missing records no doubt reduced the total counts for 2005, comparison between months for which there were complete data in both years exhibited at least a doubling of the number of downloads in the second year; the exception being September which was high in both years. Student assessments occurred in July and November for Year 1 students and in June and

October for Year 2. There was a clear increase prior to assessment occasions, particularly in relation to Year 2 assessments.

Table 2: Patterns of usage of online lectures in 2005 and 2006

	2005			2006		
Month	**Missing data (dates)**	**Frequency**	**Assessments**	**Missing data (dates)**	**Frequency**	**Assessments**
JAN					1536	
FEB					8688	
MAR		134			18468	
APR		5565			10404	
MAY	1–30	261			19852	
JUN	11–29	2765	Year 2		13746	Year 2
JUL	4–30	230	Year 1		11570	Year 1
AUG	9–31				15324	
SEP		12200			11823	
OCT		4933	Year 2		8681	Year 2
NOV		5006	Year1	1–30		Year1
DEC		1850		1-31		
Total		**32944**			**120103**	

User profiles

Students' frequency of access ranged from one download only up to 2300 across the two years investigated. Based on the frequency of use, we arbitrarily defined 'heavy', 'medium', and 'low' users. Heavy users were those with over 160 access occasions; medium users between 60-160 access occasions; and low users accessed the online lectures less than 60 occasions in a year (Figure 2).

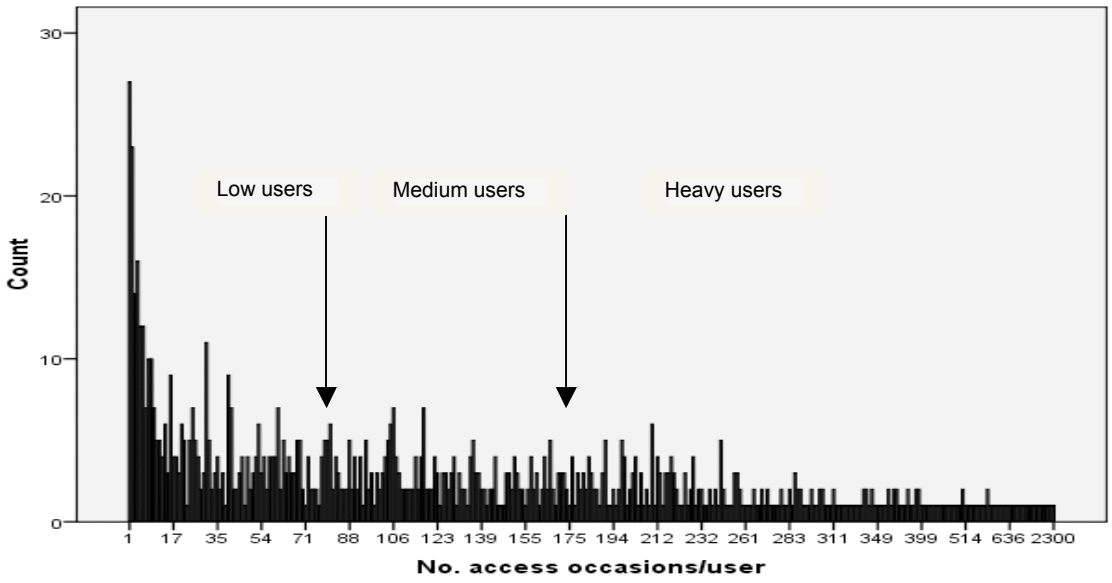
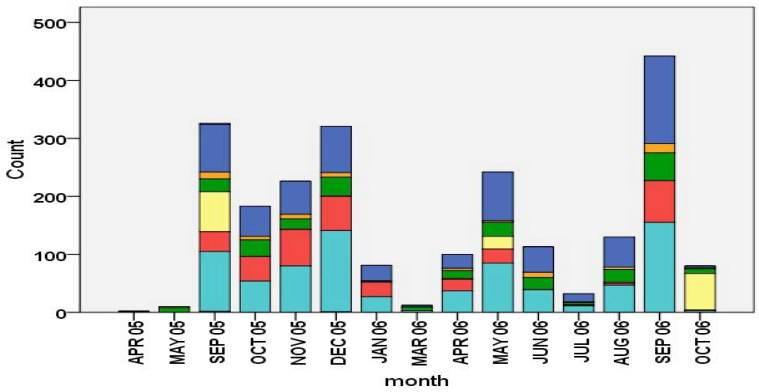


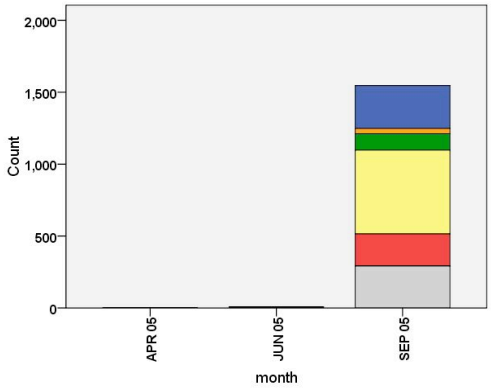
Figure 2: Frequency with which student users accessed online lectures in 2005 and 2006

A large proportion of the low users only accessed the online lectures once. While a high number of students accessed the online lectures infrequently, the majority could be designated 'medium users'. Medium users appeared to use a strategic approach; downloading specific lectures in a variety of preferred formats. While few fell into the 'heavy user' category, these students made extensive use of the resource (Figure 2). For this paper, we further explored the usage patterns of some of the heavy users, and have presented three different approaches/profiles as examples.

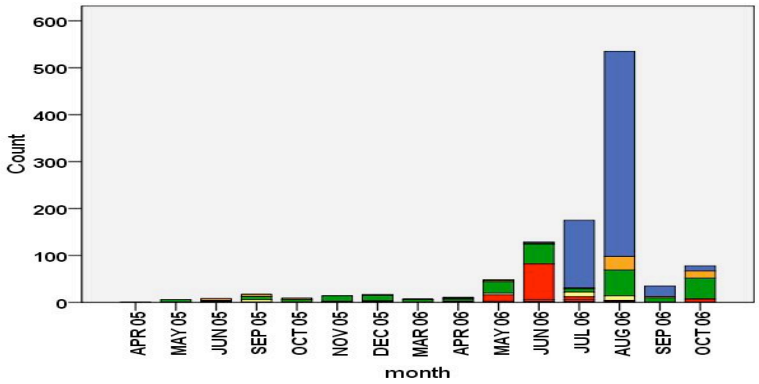
a. Sam (Year 1 in 2005; Year 2 in 2006)



b. Alex (Year 2 in 2005)



c. Chris (Year 1 in 2005; Year 2 in 2006)



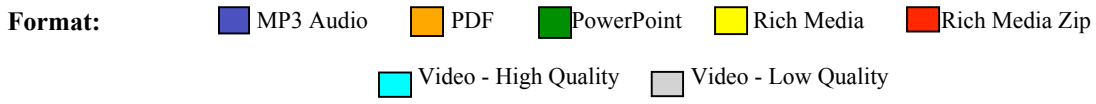


Figure 3: User patterns for three heavy users

Heavy User 1 ('Sam' - common pseudonyms were chosen to represent either male or female students) (Year 1 in 2005, Year 2 in 2006) made consistent use of the online lectures in both years, in particular using High Quality Video and MP3 Audio, with a total of over 2000 access occasions. Records showed downloading of 2005 lectures in 2006; possibly pre-lecture to prepare or have available during the lecture, or to compare any changes in delivery of the lectures in each year. Downloads increased somewhat prior to each assessment occasion, with material from both Years 1 and 2 accessed in both years (Figure 3a).

Heavy User 2 ('Alex')[1] (Year 2 in 2005) made minimal use of the online lectures in April and June but heavy use in September, although the total number of downloads exceeded 1500. This student preferred Rich Media followed by MP3 Audio files (Figure 3b). This suggests a learner who prefers to download the media files for reuse when offline or the use of mobile media players not reliant on internet connections for replay.

Heavy User 3 ('Chris') [1] (Year 1 in 2005, Year 2 in 2006) made little use of the online lectures in the first year, but use greatly increased during second year. Formats used were mainly Audio, followed by

PowerPoint, with a total of over 1000 downloads (Figure 3c). This student downloaded almost all lectures in MP3 format, supplementing many of them with either PowerPoint or PDF formats, and accessed both 2005 and 2006 versions of Year 2 material.

Discussion

This study shows the benefits of using log file data to investigate interactions between the user and the system. Distinct patterns of usage emerged, suggesting that the resource served a number of different needs for the students, from preparation for future learning through to consolidation and revision of the material at a later stage.

We originally analysed the log files as part of a cost benefit analysis of the online lectures for the USydMP. Making the lectures available online costs in the order of $150 per lecture, and the time and cost of providing each format must obviously be weighed against alternative formats of web based learning materials and the promotion of good principles of learning to make the best use of finite resources.

Our analysis indicated an extremely high uptake by students of the online lectures. Students appeared to find these materials valuable, including students not currently enrolled in Years 1 and 2. The use of this resource increased dramatically between the first and second year they were available, as found elsewhere (Parvati et al 2000). If for any reason this resource was no longer provided there would no doubt be widespread protest from the students; delays in uploading or temporary unavailability already solicit complaints from students.

Initially, we provided as many formats as conveniently possible. A practical outcome of this analysis was confirmation of the utility of providing a range of digital formats of the lectures. The available formats appear to support a range of different learning styles among students by lending themselves to different modes of study. The above analysis shows that, although there were general preferences, there was not a clear-cut rejection of any format (other than the Low Quality video, which was difficult to use).

A weakness of our study was the missing values during the first year the online lectures were available. However there was sufficient data at other times and throughout the second year to enable some conclusions to be drawn. These routinely collected data provided an objective record and effective method for monitoring use of the resources. Our overall findings regarding when and how the online lectures were used can easily be confirmed or refuted by reviewing data collected in subsequent years.

There was a wide range in frequency of use, suggesting the material was accessed for different purposes by different users. The high number of students who accessed the online lectures only a few times may represent those who experimented but chose not to continue, either because they did not find the resource useful for their learning or because their own technical facilities did not permit them to access the online lectures in a format they preferred. Some of our investigations of different individual patterns of use (not reported here) found some users tried out a number of formats before selecting the one which best suited their purpose. Alternatively some infrequent users may have been making up an occasional missed lecture or reviewing some challenging content, reflecting what others have found (Parvati et al 2000; Collie et al 2009). Other Year 1 and 2 students used the resource more frequently, presumably to replay all or part of the lectures to review material and/or to prepare for assessments. While assessment occasions coincided with some of the missing data in 2005, usage patterns in 2006 suggest that students make more use of the online lectures prior to each assessment occasion. This was the case among the Year 2 students. It should be noted that the two assessments in Year 1 and the June assessment in Year 2 were only formative, while the one in October of Year 2 was a barrier assessment. Overall use by Year 2 students was higher across the whole of their second year; possibly reflecting more active involvement in their learning. Use of independent study groups increased particularly in Year 2, with students reporting review of lecture material along with learning topics and PBL case notes as the main ways to prepare for these meetings (Hendry et al 2005). Increased use around assessment time was also particularly evident among Year 3, and even Year 4, students. This provides evidence that the students move freely between independent and dependent spaces for their learning.

Unlike a number of other published reports where the quality of online lectures was an issue (Donnan et al 2004), the techniques used to develop the online lectures for the USydMP ensured a high quality product. Choice of format was thus influenced more by personal preference or technical limitations. As indicated in Table 1, PowerPoint was the most preferred format, suggesting that the students were visual learners wanting access to specific content, perhaps to review or revise lectures or to supplement their own notes. MP3 Audio allowed students to engage in mobile learning and may have been used to confirm

the visual material (Herrington et al 2008). The PDF format was most likely used for note taking during or following the lectures. Anecdotal reports suggested that the students commonly print the PDF version of the PowerPoint and use it for pre-reading or note-taking during the lecture. Additional analysis (not shown here) showed that the lectures were downloaded before the lecture was delivered with increasing frequency across the year. Given that a lecture could not be made available until after the face-to-face lecture had taken place, this explains the high frequency of access of the 2005 lectures in 2006.

Log file data can provide additional value as a research instrument by identifying users on each use occasion, thus allowing exploration of the different ways in which the students used the online material (von Konsky et al 2009). Our brief exploration of three examples of different usage patterns in the early years of the USydMP program may also reflect different learning styles. Sam, for example, appeared to work consistently across the two years, and to have embraced the philosophy of active learning. Records showed downloading of 2005 lectures in 2006; possibly in preparation for a lecture, for note taking during the 2006 lectures, or to compare any changes between the means by which lectures were delivered in each year. The high use of High Quality Video and MP3 Audio suggested an intense study program. We have designated this student as a 'self-directed learner'. Alex, on the other hand, may well have left study until shortly before the barrier assessment, suggesting a high level of last minute cramming and possibly a more surface learning approach to study. Preferred formats were Rich Media and MP3 Audio. While Audio can be used constructively to clarify key points misunderstood during a lecture, its use may also reflect a belief that heavy exposure leads to the increased absorption of the learning materials. While Chris may have taken a more lax approach to Year 1, this student demonstrated a higher commitment to study during most of the second year. Use of Audio was particularly high, most noticeably building up to the barrier assessment in October which enabled the affordances of mobile learning spaces to be maximized in time for this assessment. This student may have taken a more strategic approach to learning. There is evidence that a proportion of the Year 1 students coast through their first year of the USydMP; this was thought to be due to the absence of a barrier assessment in Year 1. As a result, a barrier has now been introduced. The way a student goes about using WBLT is critical for whether learning is taking place (von Konsky et al 2009). While these are only three examples from among the Heavy Users, the different patterns of use of online lectures may, we hypothesize, signify different approaches to study. It would be interesting to discover how each of these students performed in the assessments, in any evaluation of their learning styles (such as Biggs' Study Process Questionnaire [Biggs et al, 2001]), as well as their approach to life-long learning.

The increased 'technologizing' of the delivery of the curriculum in higher education is inevitable. Now that these USydMP lectures have been made available online, it is likely that they will continue to be, regardless of staff concerns. It is important, however, to ensure that this process is not just a matter of 'technology driving change' but that the effects of the process are evaluated in terms of the impact on learning. Our study has described a situation in which students were provided with the opportunity to move between dependent face-to-face teaching activities and independent learning spaces where they interacted with a range of web-based learning materials. The independent spaces complemented student learning and did not replace learning in dependent spaces. It has been shown that WBLT did not result in substantial reduction in attendance at lectures, but were primarily used to revise, review and replace missed lectures (Parvati et al 2000; von Konsky et al 2009). WBLT can also be of particular value for students from non-English speaking backgrounds (McCrohon et al 2001), those who may have misunderstood certain lectures or sections of a lecture they attended. Students also use the previous years' lectures for note-taking during the face-to-face lectures. The concern expressed by staff regarding attendance patterns at lectures appeared to be insignificant in comparison to the potential value of online lectures as an aid for self-directed learning.

Our investigation of differing patterns of WBLT usage infers potential for further educational development and research. Making online lectures available 'on demand' is an extremely valuable resource for the truly self-directed learner, and a positive step given that the USydMP champions a student-centred approach and active learning (Sefton 1995). There is some evidence that access to lecture material online promotes active learning on the part of the student, by moving away from 'transmitting information' from staff to student to one where the student can control what, when and how often he/she can access learning material (McCrohon et al 2001). Video is particularly valuable for students who respond well to visual cues, and providing visual in addition to auditory stimulus can enhance the learning situation (Fardon 2003; Whatley & Ahmad 2007).

It is thus cogent to consider how WBLT can provide most benefit. Guidelines that emerged from the work of Gosper et al (2008) reinforce the notion that WBLT should not be used in isolation and careful consideration be given to its role in the overall curriculum. WBLT resources need to align with other teaching and learning activities and assessment. In addition, WBLT is not a one size fits all solution and

needs to integrate with other activities to enhance student learning. Given the structure of the USydMP and content management system, perhaps this could be achieved by incorporating interactive links and questions to the slides which encourage students to self-evaluate, or complete a task to assess knowledge levels, truly maximising the capabilities of a blended learning system. We would add from this research that institutions should strive to provide a wide choice of formats, including those that are accessible in mobile learning spaces and downloadable formats to enable access while not connected to the internet. It is clear from our analysis of the patterns of usage that students may select different file formats of the same lecture and combine them to suit their needs. In addition we would recommend that lectures from prior years be available alongside newer recordings for all years of students. This has implications for the storage and retrieval of WBLT, which, if delivered through the unit/subject based LMS site, may not easily allow this degree of flexibility as the common life of a unit of study is restricted to one semester of student access.

Considering online lectures as part of a more interactive approach to learning can assist both staff (in considering where their material links with other parts of the curriculum to enhance learning and achieving the learning outcomes), and students in achieving these outcomes while engaging in an active approach to learning. Linking WBLT with other web-based resources can develop richer learning environments for students with interactivity being an important dimension in this process; in other words, contextualizing learning (Donnan et al 2004). It is likely that students who have adopted an active approach to learning will make the best use of the online lectures to enhance their learning. As suggested by von Krosky et al (2009), the key issue is not one of interaction with the technology per se, but engagement. The data presented here shows that Sam had a high level of engagement with the information, and the resource served multiple purposes for him/her, as compared with Alex who primarily used it for revision. To avoid widening the gap between students typified by Sam and Alex it may be necessary to consider ways to assist those less far along the continuum between surface and deep learning to move in a positive direction. Further research should explore the congruence between online lecture usage patterns and learning styles, and the degree with which students engage with their learning materials. Without further data collection however, we cannot determine the degree of learning which actually occurred as a result of interacting with the resource. Log data for individual students could then be compared with those who spent less time with the resource, and ultimately, correlated with exam performance, or other learning outcomes. Such evidence based approaches to education can inform staff as to the most effective strategies for engaging their students in learning in meaningful ways.

Conclusion

We have presented a novel way of exploring log file data in more depth to discover how students use online lecture material, as well as describing the response by students in the USydMP to the introduction of this resource. We propose that log file data also offers a mechanism to further investigate students' learning styles and how they move in blended learning spaces. Use of both qualitative and quantitative methods can provide a deeper understanding of how students interact with WBLT and how this interrelationship contributes to their learning.

Access to online lectures in addition to the variety of other learning materials can provide opportunities for students to become more active learners. It is possible to link online lectures with other learning materials, and to re-think the role of the lecture in the learning process. In moving forward, 'the current pedagogical challenge for educators using this medium seems to move beyond the 'mere' instructivist, to encompass the collaborative, contextualised and conversational modes familiar to networked learning' (Young & Asensio 2002). Our method for making use of routinely collected log file data can contribute to understanding the way students learn.

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