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Sessional, weekly and diurnal patterns of computer lab usage by students attending a regional University in Australia

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Abstract

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Keywords

post-secondary education; human-computer interface; teaching/learning strategies; learning communities; computing infrastructure.

Introduction

Universities are increasingly interested in how students learn and how they make use of the facilities available to them. This interest is spurred by the need to provide student-centred high quality education in an increasingly competitive tertiary education environment. At the same time there is a growing need to keep down costs in an age of reduced government funding paralleled with increased financial pressure from rising infrastructure and salary costs.

Universities are well aware of the 'boom and bust' nature of resource utilisation. Institutions have often been admonished for the fact that their expensive brick-and-mortar infrastructure is only used for 34 weeks of the year but stands idle for the remaining 18 weeks. To alleviate this, some institutions have moved to a trimester teaching cycle for at least some of their courses, which in turn allows for a more all-year round utilisation of their infrastructure. While trimesters allow spacing the load over more weeks of the year, the confines of the standard work week comprised

of five working days and two weekend days, as well as the confines of a normal work day focussed on day-light hours remain.

At the same time, many universities provide additional learning and teaching resources on-line and combine them with student discussion forums (cf. Burr & Spennemann 2004). This has led to the notion of a 24/7 availability of university learning (and to a degree teaching) with the concomitant assumption that students would actually make use of these offerings (Gorman 2003).

Ultimately, only an in-depth understanding of the student usage of the facilities and services will allow university administrators to appropriately tailor their approaches and the implementation of innovations. Previous studies of computer use by Charles Sturt University students looked at questions of e-mail use (Spennemann 1997; Spennemann & Atkinson 2003); data management (Spennemann & Atkinson 2002b); use of web browsers and other programs (Spennemann & Atkinson 2002) as well as student's use of on-line discussion forums (Burr & Spennemann 2004). Other literature looked at the establishment of the computing and IT communications infrastructure, such as e-box (Burr & Smith 2003a), the implications of mandatory internet access for all enrolled students (Smith & Burr 2005) as well as issues of access equity between rural and urban areas (Burr & Smith 2003b).

Most universities have invested in extensive infrastructure in form of computer laboratories and computer kiosks (McMeekin & Wheeler 1999, but see McVay 2005 for laptop based strategy). The presence of these has always been justified by need to have laboratories for IT-based instruction, as well as for reasons of equity of access (see policies if most universities accessible on-line). One has to ask, however, whether the equity driven need for access still exists. After all, studies have shown a phenomenal growth of the Internet usage in Australia, with the number of households connected to the Internet increasing from 6% in 1996 to 53% in 2003 (ABS 1997; 2004). It has been posited that in this day and age students work predominantly from home using their own computers, or that that they use their own laptop sin the classrooms.

The only way to assess the situation is through an investigation of the actual usage such computer laboratories receive from students. Intriguingly, a search of the relevant literature has shown a dearth of information on exactly how students use university facilities.

The objective of the present paper is to provide an empirical study investigating how students at a regional multi-campus university use computer laboratories. It does so by examining the sessional, weekly and diurnal patterns in computer lab use and relates them to the on-campus presence of students.

The setting

Established in 1989, Charles Sturt University is a multi-campus institution in New South Wales, Australia. It maintains campuses in Albury-Wodonga (with a satellite campus at Thurgoona), Bathurst, Dubbo, Wagga Wagga and Orange (as of 2005), with associated facilities in Goulburn and study centres in additional localities. The staff establishment comprises of 422 academic and 945 administrative staff (full-time equivalent).

In 2003, the majority of a total enrolment of 38,365 students studied via distance education (71.8%), with another 10.1% studying bimodal (i.e. some of the subjects in distance education mode). On average, on-campus students are younger than distance education students, with little difference between the genders. In Albury-Wodonga and Bathurst the gender balance is skewed towards females, while in Goulburn and Wagga Wagga males in the majority.

Table 1. Gender and age breakdown of the on-campus CSU student population in 2003 (Spennemann 2004, mixed mode students added)

Campus	Total	Percent		Average Age (years)	
		Women	Men	Women	Men
Albury-Wodonga	1649	67.6	32.4	23.3	24.3
Bathurst	3063	63.0	37.0	22.0	23.3
Dubbo	363	79.1	20.9	26.1	29.7
Goulburn	1562	32.7	67.3	26.3	27.2
Wagga Wagga	3199	31.8	68.2	22.9	23.5
Other	959	58.1	41.9	29.4	28.4

Bathurst and Wagga Wagga are established major campuses, developed from the former Mitchell Teacher's College (Bathurst) and the Wagga Wagga Agricultural College. Albury, on the other hand, is a more recent campus, developed in the 1980s and 1990s on a city block in Albury. Demand for space resulted in the development of a satellite green-fields campus, Thurgoona in 1999. During the time span covered by this study, June 2001 to June 2003, the student population of the Albury-Thurgoona Campus continually expanded with the introduction of new courses. The vast majority of courses offered on-campus are undergraduate courses, with postgraduate courses being offered largely by distance education.

Computer Laboratories

In total 463 IBM machines and 99 Apple Macintosh computers are available to students. These machines are scattered in computer laboratories, media centres as well as libraries. Access to most of these machines is during business hours only (08:00 to 18:00/21:00), with a number of machines on each campus accessible 24 hours a day (Table 2). Access to the machines is unlimited, unless the laboratories are booked for IT-based teaching activities.

Table 2. Student Access Computer Infrastructure (machines)

	Business Hours Only		24-Hour Access	
	IBM	Apple	IBM	Apple
Albury	8	–	30	15
Thurgoona	49	–	20	–
Bathurst	191	45	21	7
Wagga	96	16	48	16
Total	344	61	119	38

For reasons of network security, Charles Sturt University denied student laptops access to the CSU network at the time of the data collection. For the same reason, Wi-Fi access was also not provided.

The Data

The data were collected to better understand the demands student computer laboratories placed on the Division of Information Technology, which is charged with providing IT infrastructure throughout the university. The bulk of undergraduate courses at Charles Sturt University are taught in semesters. Consequently, the data collection period ran from June 2001 to June 2003, spanning covering two (southern) autumn and two spring semesters, as well as the inter-semester periods and the mid-semester breaks. Table 3 sets out the key academic dates for the period.

Table 3. Key academic dates for the period covered in this study

Session	On-campus classes		Residential schools		On-campus classes		Examinations	
Spring 2001	23 Jul	7 Sep	9 Sep	29 Sep	2 Oct	9 Nov	12 Nov	23 Nov
Autumn 2002	18 Feb	29 Mar	2 Apr	20 Apr	22 Apr	7 Jun	11 Jun	21 Jun
Spring 2002	22 Jul	6 Sep	8 Sep	28 Sep	30 Sep	8 Nov	11 Nov	22 Nov
Autumn 2003	24 Feb	18 Apr	22 Apr	10 May	12 May	13 Jun	16 Jun	27 Jun

All individual log-ins were extracted from log files, aggregated into numbers of log-ins per laboratory computer and broken down by major category (by week of the year, by day of the week, by hour). These aggregated data, which are devoid of any personal student information, were provided to the authors for analysis. At the time of writing only the aggregated data remain available, which provide some limitations as to the questions that can be asked. These limitations are addressed where relevant.

Excluded from the initial data capture were log-in data for access to the Apple Macintosh laboratories. Even though Apple Computers make up about 20% of the total of 562 machines installed at Albury-Thurgoona, Bathurst and Wagga Wagga, (Table 2), data on program usage show that only 1% of the demand for Microsoft Word/Excel/Powerpoint and 2.7% of the demand for web browsers (Internet Explorer/Netscape) originates from Macintosh computers. In the light of this small percentage the omission of these lab data does not cause concern to the validity of the analysis, although it

is acknowledged that they can still represent access to specialist software which not be available elsewhere.

Computer lab use

The academic life of students on campus revolves around semesters, and within semesters around class days and the teaching-free weekends. Correspondingly, the analysis of computer laboratory use and the assessment of any emerging patterns, can be carried out on three levels: an analysis by semester, an analysis by day of the week, and an analysis of the usage by time of day. In the following we will look at each of these in turn.

Semester analysis

The weekly graph of all log-ins between mid 2001 (week 26) and mid 2003 (week 30) demonstrates clearly the semester pattern of undergraduate study (Figure 1). At the beginning of the year (week 1) the numbers slowly rise until the start of the autumn semester (week 6), when the log-ins rapidly increase. The number of log-ins remains high during the first part of term, drops off dramatically during the mid-term break, rises again during the second part of term, and drops off at the end of the semester. There are some log-ins during the mid-year break, but fewer than during the mid-term breaks. This suggests that more students leave campus during the four week break in winter than during the mid-term break—an observation that is borne out by anecdotal evidence as well as the personal experiences of the authors. The spring semester repeats the pattern of the autumn semester. During the long (southern) summer break the number of log-ins decrease to very low levels, dropping to zero during the Christmas/New Year period when the University formally shuts down.

This semester-based log-in pattern conforms to expectations, *ie.* that the number of log-ins in the computer labs is directly related to the presence of large numbers of students on campus. Worth noting, however, is the observation that (southern) autumns terms the overall number of log ins after each mid-term break is less than before the break, while the reverse seems true for the spring terms.

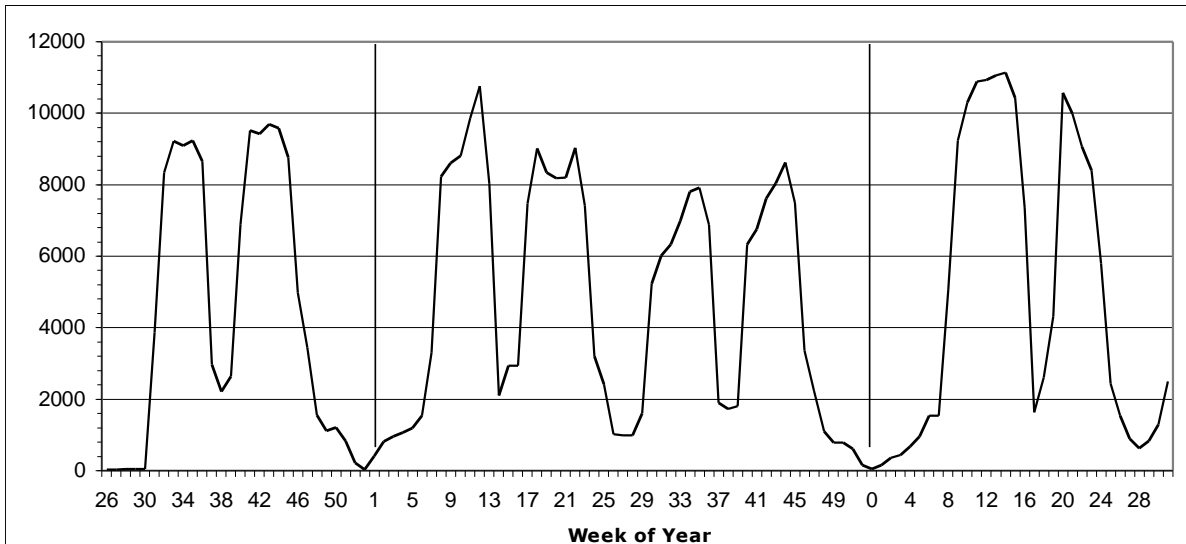


Figure 1. Distribution of computer log ins mid-2001 to mid-2003.

Because of the mid-year start and end of the data series, 2002 is the only year for which a detailed comparison on a whole-of year basis can be made (Figure 2 with the four campuses plotted as two graphs to improve readability). It is clear fact that the log-in frequency is higher for the (southern) autumn term than for the spring term. This holds true to varying extent for each of the four campuses. Similar are also the patterns within each of the semesters and terms. For example, both terms in the spring semester have pronounced peaks near the end of each term, suggesting that computers are more frequently accessed to complete assignments as well as to prepare for the end of term examinations. In contrast, the distribution during the autumn term shows a single peak before the mid-term break, but two subpeaks after the break. That for the most part, with the exception of Albury, the curves for the campuses are so similar, suggests that the underlying pattern of computer use is a general one, rather than a cohort-specific one. During 2002 the population of students on Albury Campus was dominated by a single discipline, namely Allied Health courses (Nursing, Occupational Therapy, Speech Therapy, Podiatry etc), while the other campuses have a mix of Sciences, Business, Humanities and Health (not Thurgoona). It is thus possible that the pattern for Albury may be discipline specific rather than generic.

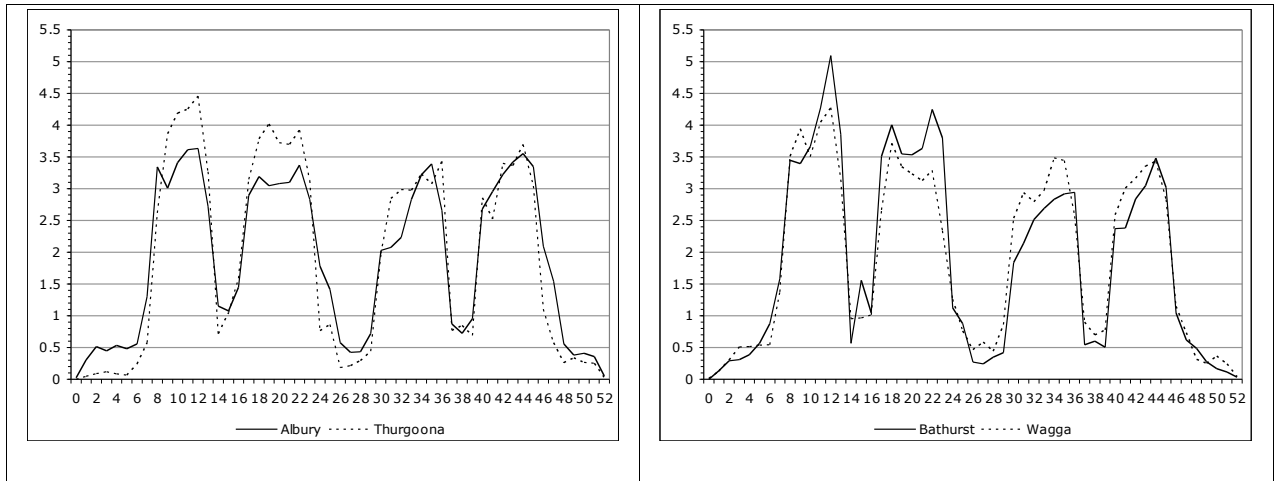


Figure 2. Sessional distribution of computer log-ins during 2002 (expressed in % of entire year)

Overall, the time students accessed the computer labs outside of term was minimal. The vast majority of the utilisation of the computer laboratories occurs during the semester period (86% of all log-ins), with the rest distributed across the residential school breaks in the middle of semesters, as well as the mid- and end-of-year breaks (Table 4). While the representation of the term weeks in the patterns was to be expected, the different length of the various periods in the dataset distorts the analysis. Table 5 shows the average number of log-ins per week for each of the periods, again broken down by campus. This more accurately reflects the actual pattern.

Table 4. Utilisation of the computer labs during and after semesters (in % of logins)

	During Semester	Residential Schools	Mid-Year Break	End of Year Break	n
Albury	85.0	6.6	2.8	5.5	130785
Thurgoona	89.8	5.9	2.0	2.4	46545
Bathurst	88.9	5.0	2.0	4.1	164370
Wagga	87.0	5.6	3.0	4.4	175546
Whole of CSU	87.3	5.7	2.6	4.4	517246

Students are three times less likely to be utilising the computer labs during residential school and five times less likely to be using the labs during the four-week mid-year break in the (southern) winter. Both the three-week mid-term and the four-week mid-year break see a dramatic drop in on-campus presence of students. Yet the fraction of students using the lab machines during the mid-term break is on average 1.7 time greater than during the mid-semester break. While it is possible that many on-campus students indeed remain on-campus and use the facilities during that period, the difference between the two periods is most likely caused by distance education students who use the lab facilities while present on campus for residential schools.

Table 5. Average number of log-ins per week

	During Semesters (59 weeks)	Residential Schools (12 weeks)	Mid-Year Break (10 weeks)	End of Year Break (27 weeks)
Albury	1884.6	717.9	414.0	278.8
Thurgoona	708.3	227.4	103.4	42.2
Bathurst	2475.6	684.1	366.2	261.7
Wagga	2587.5	826.2	586.0	296.0
Total	7656.0	2455.6	1469.7	878.8

There is also a difference in computer access between Bathurst and the other two campuses. Anecdotal evidence suggests that many students in Bathurst leave for Sydney on weekends, which for that campus poses problems to schedule classes on Fridays and in particular Friday afternoon (Spennemann 2004). It is likely that the same pressure could account for the drop in the Bathurst population during the off-term periods.

However, the access opportunities for a given student vary from campus to campus, depending on the number of computer laboratories on each campus, the number of machines per laboratory, and the opening hours for each laboratory during the weeks. Moreover, some laboratories are only open during working hours during a term. To cater for these factors a variable of 'machine-access-hours' (calculated as number of machines per lab x access hours for that laboratory) was created (Table 6).

Table 6. Machine Access Hours

	08:00–18:00	After Hours	Total	08:00–18:00	After Hours
Albury	2100	2940	5040	41.7	58.3
Thurgoona	3400	2100	5900	61.8	38.2
Bathurst	4951	4613	9564	51.8	48.2
Wagga	5760	5520	11280	51.1	48.9
Total	16211	15173	31784	51.7	48.3

The duration (in time) of each individual computer log in was not measured. Each log-in was merely logged as a single event, irrespective of whether a student used a machine for ten minutes or for eight hours. It is not possible to ascertain from the data made available to the researchers what the actual log-in time was. To approximate the machine availability, some time information can be gleaned from the statistics gathered on the utilisation of the key server, which serves standard applications to all machines on the CSU network. Data collected for the period April to October 2003 suggest that the average log-in time to the server was 1.03 hours (1 hour and 20 seconds). Using the figure of one hour as the average log-in duration we can equate a log-in with a one-hour utilisation of a machine. This allows us to compare the actual utilisation of machines with the total machine hours available, which provides a figure of laboratory utilisation (Table 7). Overall, the utilisation during term ranges from 13.3% to 38.5%, dropping off to 4.3% to 14.7% during the residential school period.

In interpreting these data we need to be conscious of the fact that the total machine hours covers both laboratories that are open during business hours only and labs that are open twenty-four hours a day. In view of the diurnal patterns observed (see below), it is worth comparing the average machine utilisation with the percentage of machine hours available during business hours (i.e. 08:00 to 18:00, see Table 7). This shows up some inter-campus differences.

Table 7. Average Machine Utilisation (in % of access hours of all four terms analysed)

	Access Hours 08:00-18:00 (%)	During Semesters (59 weeks)	Residential Schools (12 weeks)	Mid-Year Break (10 weeks)	End of Year Break (27 weeks)
Albury	41.7	38.5	14.7	8.5	5.7
Thurgoona	61.8	13.3	4.3	1.9	0.8
Bathurst	51.8	26.7	7.4	3.9	2.8
Wagga	51.1	23.6	7.5	5.4	2.7
Total	51.7	25.1	8.1	4.8	2.9

On an average individual student basis, further differences can be observed between Albury and Thurgoona on the one hand and Bathurst and Wagga on the other. The figures are derived by dividing the average number of weekly log-ins by the number of on-Campus students (Table 8). In view of the observations on the duration of the average log-in, the figures also express the average duration of log-ins (in hours). While the average number of weekly log-ins almost exclusively comprises of internal students during term, as well as during the mid-year and end-of year breaks, the figures for the residential school period will include some distance education students.

During term the average number of log-ins per student is less than one per week at Bathurst and Wagga Wagga. Only at the Albury-Thurgoona Campus is the number of weekly logins more than once a week—in fact double that of each of the other campuses. The differences between the campuses continue during the residential school period as well as the mid-year and end-of-year breaks. In all cases, Albury-Thurgoona log ins were twice as high as those at Bathurst and Wagga Wagga.

The average number of log-ins during the residential school period was about one third of that during the term period, and about one fifth during the mid-year break. During the end-of-year period the usage was down to one ninth of the term period. We can speculate that this utilisation was confined to students permanently resident at the campus locations and who do not own their own computers (student on-campus residencies will typically have on-line access provided by university broadband in their rooms), as well as students required to complete outstanding assignments.

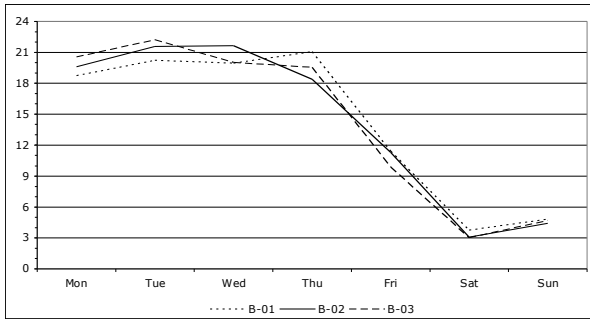
Table 8. Average number of log-ins per student and week

	During Semesters (59 weeks)	Residential Schools (12 weeks)	Mid-Year Break (10 weeks)	End of Year Break (27 weeks)
Albury/Thurgoona	1.57	0.57	0.31	0.19
Bathurst	0.81	0.22	0.12	0.09
Wagga	0.81	0.26	0.18	0.09
Total	0.97	0.31	0.19	0.11

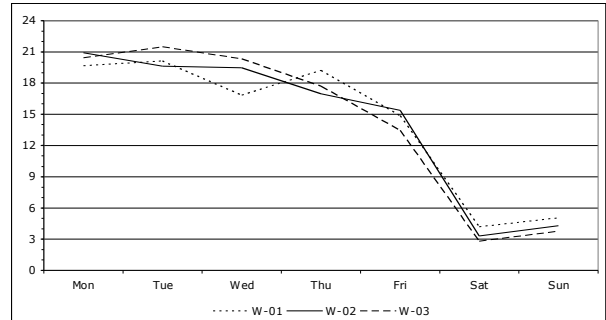
Day of the Week Analysis

Human behaviour in western cultural environments follows a pattern of work days and work-free weekends (Klepeis *et al.* 2001; Spennemann *in press*; . Tertiary education in Australia is no different in that regard, the new on-line teaching methods notwithstanding (cf. Burr & Spennemann 2004). It can be expected that students will follow that pattern.

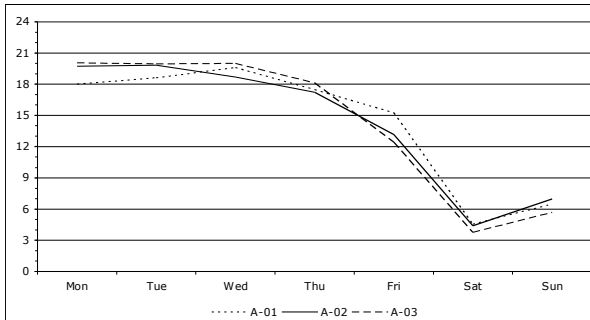
An analysis of the day of the week when students access computer laboratories shows both expected and unexpected patterns (Figure 3). Expected was that both Saturday and Sunday would see very little usage, while usage between Monday to Friday would be high. Figure 3 shows the daily variation for each of the campuses. The exodus of Bathurst students on Fridays and the weekend has already been alluded to. It is certainly reflected in the day-of the-week curves. A similar curve can be observed for Thurgoona campus—a campus that in 2001 to 2003 only had a limited number of course offerings. The curves for Albury and Wagga Wagga are more flattened during the Monday to Thursday period, but also show that usage on Fridays is lower than other workdays. Common to all campuses is that the usage on weekends is very low, with the lowest usage of the week on Saturdays and a marginally better utilisation on Sundays,



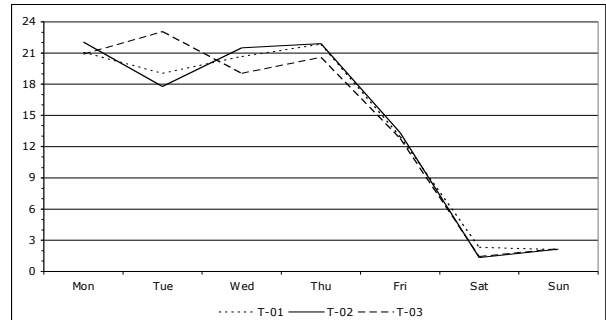
Bathurst



Wagga Wagga



Albury



Thurgoona

Figure 3. Utilisation of the computer labs by day of the week 2001-2003 (in %)

Cumulatively, ninety percent of the utilisation of the computer laboratories occurs between Monday and Thursday. Friday and the weekend were clearly periods of very low usage. How does the day-to-day of the week utilisation of the computer laboratories compare to other resources?

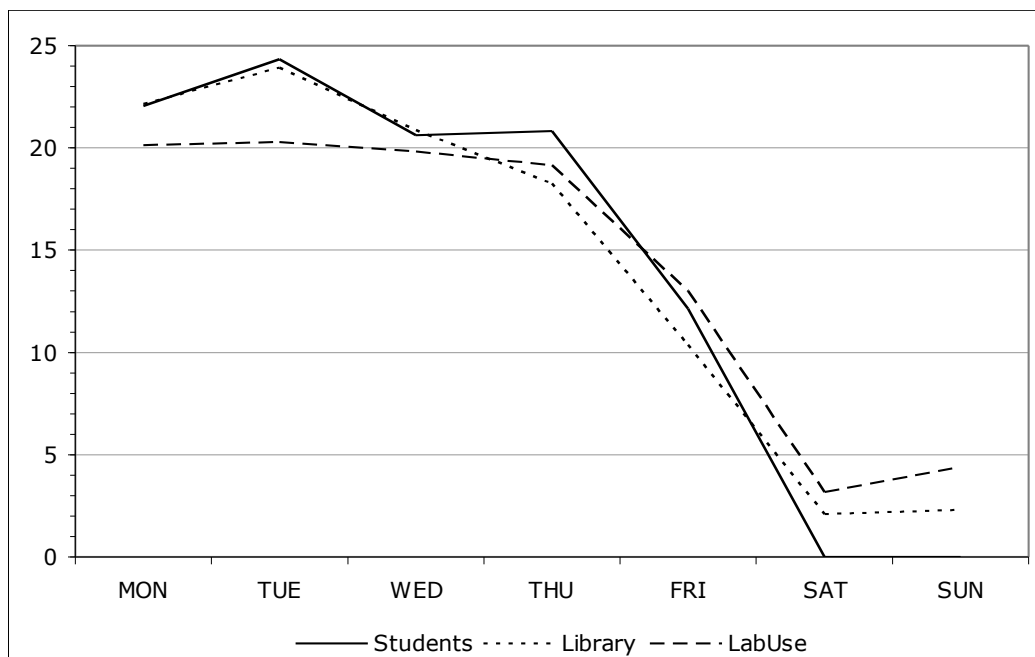


Figure 4. Comparison of the usage of computer laboratories with that of libraries and the number of students on campus (autumn 2003)

Elsewhere, Spennemann (2004) analysed the schedule on-campus presence of students during the days of the week as well as during the time of day, while Spennemann and Fry (in prep) looked at the library patronage by students. These are plotted against computer laboratory use in Figure 4. The curves show generally good agreement.

Diurnal patterns

Humanity has organised its day-to-day activities based on the diurnal patterns of sleep, work and play (Kelpais et al. 1999; for IT: Spennemann in press). To assess to what extent student behaviour and use of computer laboratory facilities conforms to this pattern, the log-ins were plotted on an hourly basis (Figure 5). The diurnal pattern is surprisingly uniform between the three years of data, showing a steep rise of computer laboratory usage between 7:00 and 9:00 and a somewhat less steep drop between 14:00 and 18:00. The pattern is strongly diurnal and shows that students do not make use of the 24/7 availability of the infrastructure. The pattern is similar for all campuses. Only Thurgoona, a campus under development with limited course offerings and limited student residence, shows a more pronounced curve (Figure 5).

A campus-based analysis, however, shows small variations (Figure 6). The diurnal curve for Bathurst shows a slight drop in use during the lunch time period, which is not observable in the other campuses.

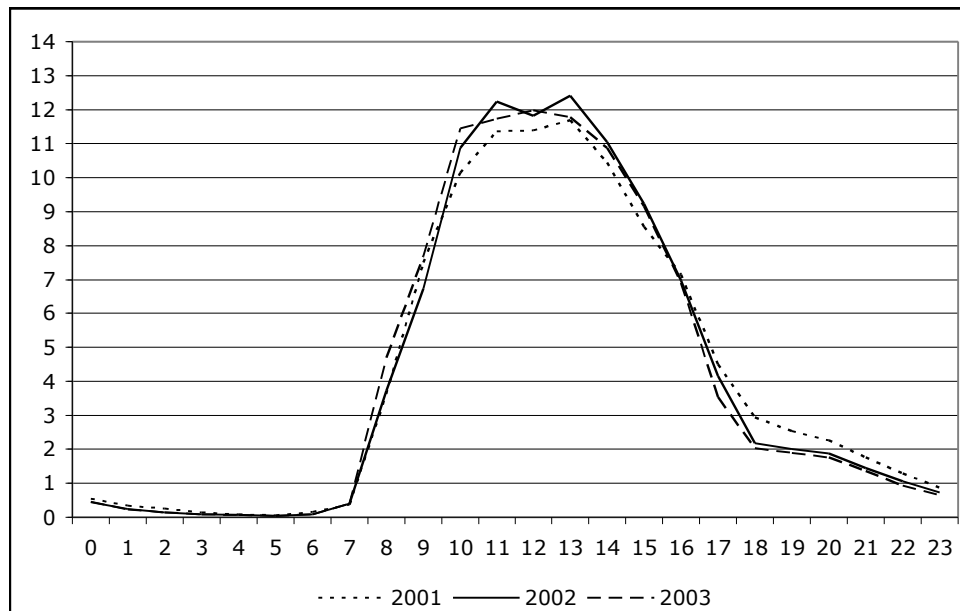
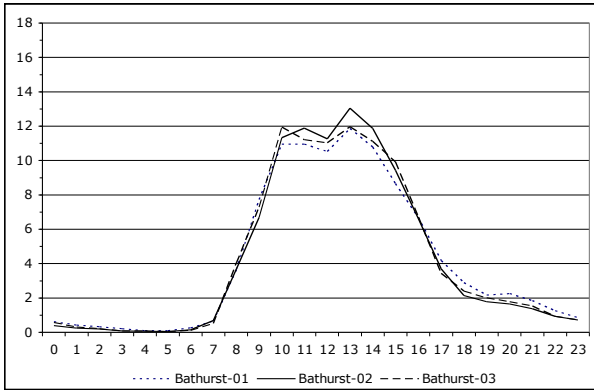
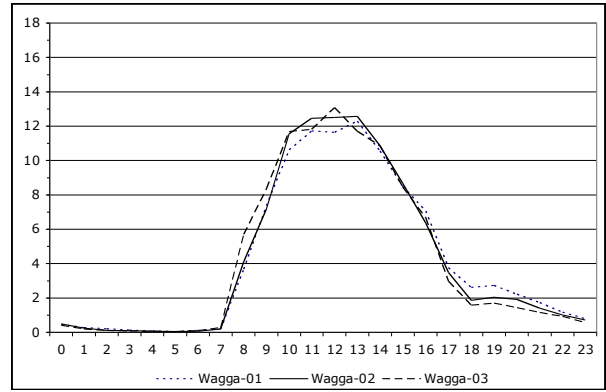


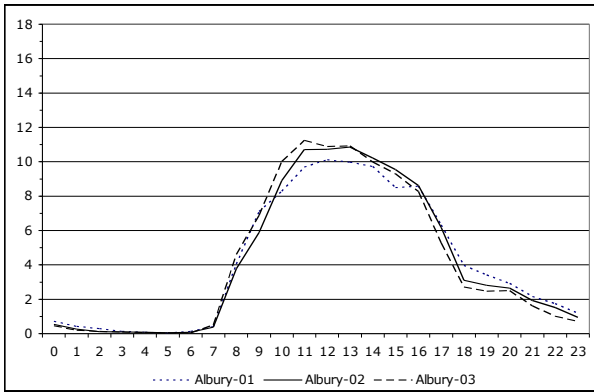
Figure 5. Access of computer labs by hours of the day, 2001-2003 all laboratories. (in %)



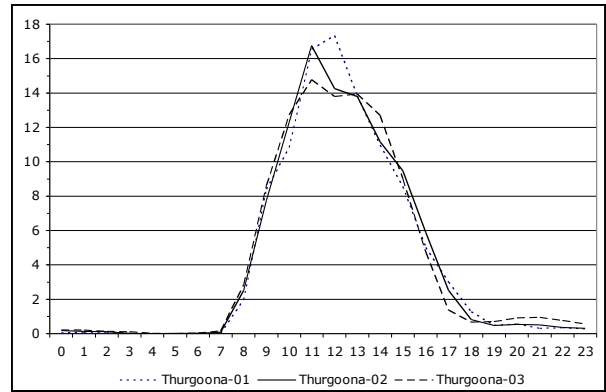
Bathurst



Wagga Wagga



Albury



Thurgoona

Figure 6. Access of computer labs by hours of the day 2001-2003 (in %)

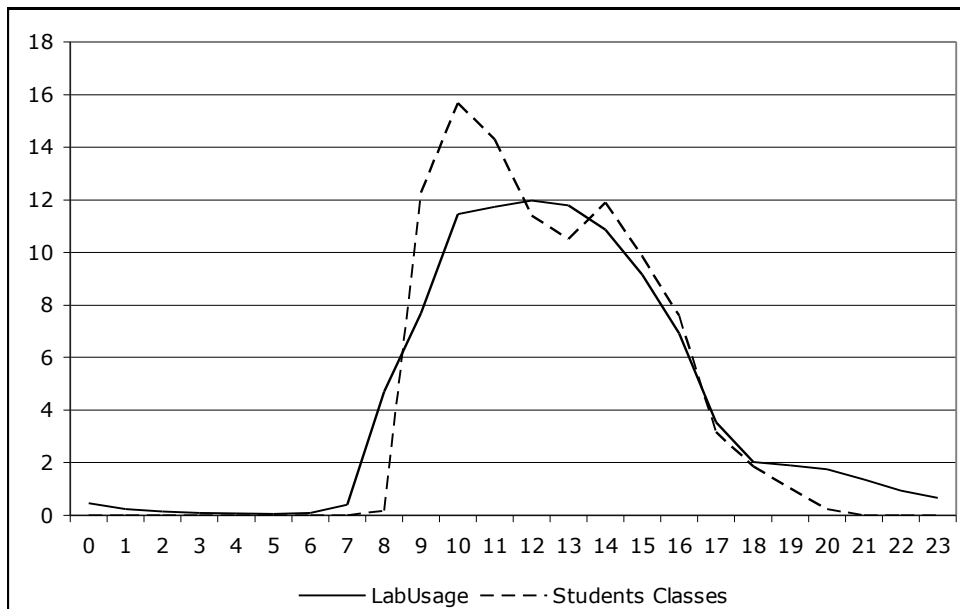


Figure 7. Comparison of students in classes with laboratory use (autumn 2003 only)

It can be assumed that the overall presence of students on campus (in order to attend classes) will be directly related to the usage of the computer laboratories. To assess this, the laboratory usage

for 2003 was plotted against the data for the on-campus presence of students in 2003 (Spennemann 2004) (Figure 7). There is generally good congruence between the two curves with a slight variation in the period between 8 am and 11am, caused by the higher presence of students in classes and the use of the computer labs in the hour before classes start.

Implications on the understanding of student learning and IT behaviour

This research has highlighted some important issues for many universities with regards to the expensive infrastructure investment they make into their computer laboratories. Universities may need to reassess the traditional driving force and expectation for extensive on-campus computing facilities as there is an apparent huge underutilisation of these facilities during particular times of the year. It appears that the majority of on-campus student will only login (86%) during the traditional business hours (Monday to Friday, 7am - 6pm) during a semester. This means that the laboratories are severely underutilised during other periods of the year such as non-business times (6pm - 8am), weekends (Saturday and Sunday), inter-semester and intra-semester breaks.

This research also determined that during normal business hours (8am - 6pm) the total available machines in the computing laboratories are only being utilised 52% of the available time. Typically this utilisation is more pronounced on Monday to Thursday although a sharp decline was identified on Fridays and leading into the weekend period. More alarming was that outside the normal teaching semester the utilisation of the computer facilities drops to very low figure (only 5% during the inter-semester breaks).

One of the main problems is that student access is very much centred on when their assessment items need to be submitted. This research found that the peak student access times occur towards the end of a semester typically when such assessment items are due. Such peaks are difficult to cater for however students may need to be a little more flexible in the times that they access the computer facilities rather than concentrating their access times in the traditional business hour periods identified above.

Finally this research identified that the average number of logins per week is less than one per week (except for one campus cohort). The above observations of low usage of computer laboratories outside working hours must not be equated with the learning and study patterns of students (for on-line behaviour of students cf. Burr & Spennemann 2004). The fact that labs are underutilised outside working hours suggests that students are not using the university computer laboratories as their main means to meet their computing needs and very likely to have widespread access to other machines.

This research clearly shows that the access to computer facilities at university by students is more than adequate. It could be

speculated that such resources are more than generous and perhaps the traditional computer laboratory could be replaced with more student centred facilities such as wireless hotspots to the university computer networks.

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