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Opportunity costs associated with the provision of student services: a case study of web-based lecture technology

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Abstract Universities aim to provide services that are not only beneficial to students but also efficient relative to possible alternative services. Using opportunity cost, this study considers staff and student perceptions of the usefulness and valuation of web-based lecture technology (WBLT). It reveals that a quarter of students did not use WBLT while many staff members thought WBLT had a negative impact on their face-to-face teaching. Further, over a third of students sampled said they would not be affected if WBLT were not made available and many staff members felt constrained by WBLT technology. Some staff members spent a lot of time preparing WBLT while others eschewed the technology altogether. Nevertheless, a relatively small number of students place enormous value on WBLT, as do some staff, even if only simple audio of lectures are provided. The academic policy implications of this study suggest that university provision of WBLT could take into account the opportunity cost of WBLT use as a valuation-basis, possibly recovering costs through extra fees. This would allow for improved decision-making by university administrators and facilitate a move towards a useful measurement basis of WBLT. A wider academic policy implication is to consider whether all universities should produce and deliver WBLT at all and to what extent it should encourage staff to develop enhanced WBLT. Provision of sophisticated WBLT or any other service for students bears an opportunity cost in terms of less preparation by staff for face-to-face lessons or other effective teaching or research.

Keywords Web-based lecture technology · Opportunity cost · Student perceptions · Teacher perceptions · Higher education policy

Introduction

Universities aim to provide a high quality teaching and learning service for their students through limited resources. While research demonstrating the effectiveness and popularity

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of services for students is important, decisions to allocate resources to a service should be performed with due regard to the opportunity costs involved. It is insufficient to demonstrate a service or approach is beneficial. It is also important to demonstrate this benefit outweighs the benefit of allocating the resources to alternative teaching strategies or non-teaching activities such as research.

This paper explores trade-offs between alternative services using web based lecture technology (WBLT) as a case study. In particular, this paper considers student and academic staff use of WBLT and face-to-face lectures, and qualitative measures of WBLT and face-to-face lectures. It is a timely study because the results will enable universities not only to consider whether they are getting 'value' from their digital technology but also whether the concept of opportunity cost has relevance in the academic decision-making processes of resource allocation.

There are many major issues facing universities that are related to WBLT. These include shrinking budgets resulting in staff being asked to do more with less (including WBLT) and an emphasis on research. Additionally the massification of higher education over the past few decades, particularly in the western world, has created student cohorts that are demographically diverse, have extensive time demands outside of university study, and expect learning support and flexibility. Universities need efficient and effective ways to deliver courses. In response to these challenges many universities world-wide have adopted information communication technologies (ICT) to provide flexible learning options. These technologies are concurrently generating new expectations for how students want to learn (Scott et al. 2009). In response to the Bradley Report (2008), government policies require the Australian higher education sector to increase participation rates in study programs which will place further demands on institutions to meet the needs of diverse cohorts. Universities cater for these diverse cohorts by flexible delivery and blended learning models of teaching utilising various ICT tools. WBLT is an example of the ICT tools that some universities use to provide students with flexible access to learning materials. This paper uses WBLT as a case study to investigate opportunity costs associated with the provision of student academic services, a methodology applicable beyond WBLT.

The vast majority of the literature on non-monetary valuation of WBLT focuses on student or staff perceptions of WBLT (Traphagan et al. 2010; Phillips et al. 2007; Day and Foley 2006). There is, however, a slim literature on monetary valuations of WBLT. For example, Balfour (2006, p2) suggested any "enhancement to student learning must be large compared to the time, money and expertise required to produce and deliver the learning resource" but acknowledged this was a 'fuzzy' term and performed no calculations.

As well as gathering student perceptions of WBLT, Taplin et al. (2011) evaluated WBLT through a number of alternative monetary valuation models. While going some way to measuring the opportunity cost of providing WBLT by placing an economic value on their availability, Taplin et al. (2011) only examined two accounting units. This paper therefore extends the research framework to subjects across a university and to include student and staff perceptions since staff are more likely to be aware of the opportunity cost they pay by devoting their limited time to WBLT.

Although there is a financial cost when universities provide lecture capture facilities, and there is a time cost for teaching staff to enable lecture capture, the past literature is less clear on the cost to students of foregoing access (or non-access) to WBLT. This is overcome by asking students to put a monetary value on lecture capture services. This monetary valuation is particularly useful because at some university campuses university

lecture capture is entrenched. It is important for universities and individual teachers to know if this monetary valuation exceeds the opportunity cost of providing other activities.

In light of this notion of trade off, the study poses the following research question:

> Does the benefit of providing WBLT exceed the opportunity cost resulting from the diversion of resources away from other activities such as face-to-face teaching?

The response to this research question may depend upon the demographics of the students, including their working and English as a second language (ESL) status (Pearce and Scutters 2010) which this study also examines. The paper is structured as follows. The next section defines and discusses the context of the study and highlights issues confronting WBLT use in universities. This is followed by the study's research method, which is then followed by the results of the paper. Finally, a conclusion is drawn in light of the results first towards the use of WBLT specifically and secondly towards higher education generally.

Opportunity cost

Cost benefit analysis may be approached through the measurement technique of opportunity cost, which is the value of the next preferred good or service you give up buying when you purchase something. By way of example, the opportunity cost of producing WBLT may be the foregone preparation of face-to-face lectures. In other words, if you spend a lot of time producing WBLT, you will have less time preparing face-to-face lectures. In the case of WBLT, for example, non-monetary valuation may be expressed in terms of willingness of students to lose the rights to access WBLT without any discount on fees, or in monetary terms as the willingness of students to pay download fees to access WBLT.

Web-based lecture technology

WBLT allows automated recording for digitally capturing face-to-face lectures for asynchronous web delivery (McNeill et al. 2007; Chang 2007). WBLT recording options include audio only, audio and power-point slide, and audio with video. The digital lecture capture is then made available to students through the learning management system (LMS). Students can stream or download the recordings with unlimited access. The university in this study began its commitment to flexible learning in 1999 with automatic recording of lectures from 2009. It uses a WBLT known as iLecture or Lectopia, which was introduced in 2002 as a tool to provide equity student support, disaster management to ensure uninterrupted course delivery, and flexible student learning support. Personal capture desk top software, Echo 360, was introduced to enable staff to create learning materials outside of the lecture theatre for release through the WBLT system.

WBLT are considered a support mechanism for students who are unable to attend lectures for a variety of reasons (Williams and Fardon 2007; McKenzie 2008). Currently, in Australia, 50 % of universities use WBLT to digitally deliver lecture materials (Lectopia 2009). Ostensibly the use of WBLT saves on infrastructure costs (Brabazon 2002), accommodates a variety of student learning styles (von Konsky et al. 2009), converges with face-to-face pedagogies (Trindade et al. 2000; Rumble 2001; Bryant et al. 2005; Woo et al. 2008) to form 'blended courses' (McElroy and Blount 2006), enhances students'

learning experience (Gosper et al. 2008), and helps students achieve better results (Williams and Fardon 2007; Gosper et al. 2007; Gosper et al. 2008; McKenzie 2008). Woo et al. (2008) found that staff perceived advantages for external students using WBLT but questioned the extent to which these advantages applied to internal students. Woo et al. (2008) also found that students were positive about the benefits of WBLT for their learning.

However, there are a number of concerns about WBLT (Baggaley 2008; Fardon 2003; Rumble, 2001; Massingham and Herrington 2006), including its impact on: student absenteeism from face-to-face lectures (Larkin 2010; Massingham and Herrington 2006; McNeill et al. 2007; McKinlay 2007)[1] student self-study discipline issues (Woo et al. 2008), pedagogical issues (Naidu 2007; Sammons 2007; Henry and Meadows 2008), and quality of courses (Wiesenberg and Stacey 2005; Larreamendy-Joerns and Leinhardt 2006; Daniel et al. 2008). A number of commentators have also questioned whether there has been sufficient, time or money devoted to designing or modifying WBLT materials (Gosper et al. 2008; Phillips et al. 2007; McNeill et al. 2007).

Methods

This study used an explanatory sequential mixed method approach (Creswell 2008). Phase one was a self-administered, written survey of students and phase two comprised interviews with academic teaching staff. The opportunity cost of WBLT can be measured by comparing to alternatives such as face-to-face lectures or with a monetary value. Hence the student survey quantified opinions in several areas: the per cent of WBLT and face-to-face lectures utilized; the effectiveness of WBLT and face-to-face lectures; the monetary value students place on WBLT. Thus not only was the value placed on WBLT by students measured in different ways, but corresponding values of face-to-face lectures were collected for comparison. Some questions on demographics of students followed: ESL, sex, and working status. Finally the questionnaire ended with a free text question "If iLecture was not available next semester, how would it affect you?"[2] Questions were based on a range of items from previous research on WBLT (Gosper et al. 2008).

The effectiveness of WBLT was measured using the same five-point Likert scale of agreement to "iLectures made it easier for me to learn" employed by previous research (Gosper et al. 2008). For comparison, and to obtain a more holistic view of student learning, we also include the similar question relating to face-to-face lecture effectiveness "face-to-face lectures made it easier for me to learn". The monetary value of WBLT was measured with two questions: the first asking students to indicate the discount (in dollars for the unit) they expect as compensation should WBLT not be available and the second for a download fee (in dollars for the unit) they were prepared to pay to download WBLT. Both questions are included due to the anticipated reluctance for students to agree to higher fees and in each case students wrote numerical responses rather than making a selection from a few presented options.

[1] Phillips et al. (2007) and von Konsky et al (2009) argue that other factors contribute to falling attendance rates. These include the increasingly complex lifestyles of students and their changed perceptions of the learning experience provided.

[2] An anonymous reviewer pointed out this question is problematic for students in their final semester of study. This affected only two surveyed units (less than 5 % of the sample) as sampling was performed at the end of first semester and so does not materially influence our results.

The 1550 students surveyed were all enrolled at a large, metropolitan, Australian university. Students included both undergraduates and graduates from 36 units where WBLT were available and across all faculties. Students were selected through convenience sampling. In contrast with some previous studies where only students who had used WBLT were surveyed (Gosper et al. 2008), this study surveyed students irrespective of their WBLT usage. The survey was administered in hard copy immediately after the examination for each unit to allow students to report on their WBLT use for a whole study period. Participation was voluntary and students agreeing to participate were rewarded with a small bag of confectionery. Units were selected for inclusion on the basis that they were large units with an examination held in the largest examination room (university stadium) where easy access to students leaving the room was available.

The second phase of the study explored the opinions, experiences, and perceptions of academic staff. Staff teaching in the 36 units where students were surveyed were contacted by email and eleven staff participated voluntarily (one staff member not using WBLT was also interviewed to investigate reasons for non-provision). Semi-structured, face-to-face interviews were conducted to contextualise the issues arising in the student surveys. Interviews with academic staff took about 30 min. The interviews were recorded and notes taken in situ. A record of the interview was provided to the participants for verification and then analysed manually to identify the main themes (Creswell 2008). The academic staff interviewed included award winning teachers, staff providing student centred face-to-face learning environments, teachers who practiced a teacher-centred approach and those who opted out of participating in WBLT. No quantitative results were presented to staff prior to the interviews in order to obtain unbiased responses and then examine to what extent these matched those of the students.

Quantitative questions from the student survey were summarised using SPSS (version 19). Student comments to the qualitative free text question were analysed manually using thematic analysis (Creswell 2008). Seven themes were identified and extracted from the open coding and axial coding. The results from staff and students were presented together, with reference to the quantitative results from students in the same unit. Interrelating the results in this way provided a more holistic view of WBLT.

Results

Response rates for the student survey are not available as numbers of students approached, but refusing to complete the survey was not recorded. However, approximately 26 % of the students taking the examinations completed the survey and as many as three quarters of the students were approached. Only 28 % of students surveyed were not working, with 55 % working part-time and 17 % working full-time. Approximately 26 % of students were ESL students and 49 % were female. The students were divided equally between science/engineering and commerce/humanities. The following four sections provide respectively student quantitative results for the three valuations of WBLT: usage, effectiveness and monetary, and then qualitative results from student comments and interviews of staff.

Student usage of WBLT and face-to-face lectures

Table 1 provides the percentage of students indicating they used between 0 and 100 % of the available WBLT and face-to-face lectures throughout the semester. One quarter (25 %) of students did not use WBLT and only 8 % of the students did not attend any face-to-face

Table 1 Student utilization rates for WBLT and face-to-face lectures

	0 %	10 %	30 %	50 %	70 %	90 %	100 %	N	Mean (%)
WBLT use[a]	25	16	16	13	13	8	8	1534	37.3
Face-to-face lecture attendance	8	7	11	13	18	26	17	1530	63.7

23 % of students used more WBLT than they attended face-to-face lectures

[a] Values do not add to 100 % due to rounding

Table 2 Student utilization rates for WBLT for low and high face-to-face lecture attendees

WBLT use	0 %	10 %	30 %	50 %	70 %	90 %	100 %	N	Mean (%)
Attend $\leq$ 50 %	21	10	14	15	16	12	12	599	46.2
Attend $>$ 50 %	28	21	18	12	11	5	6	931	31.5

lectures. The mean percentage of WBLT used was 37.3 % but attendance at face-to-face lectures was almost double (63.7 %). Despite the higher attendance at face-to-face lectures these means do not capture the variation between students or the fact that some students rely completely on WBLT rather than face-to-face lectures. For example, in a separate analysis from that tabulated, 23 % of the students used more WBLT than they attended face-to-face lectures.

WBLT usage is significantly and negatively correlated with face-to-face lecture attendance ($r = -0.192$, $P < 0.001$). Thus while there is evidence of an overall substitution effect between WBLT and face-to-face lectures, this effect is small and the correlation close to zero suggests this is not the case for all students. Table 2 provides the distribution of WBLT usage for two subsets of students: those who attended at most half the face-to-face lectures (599 students) and those attending a majority of the lectures (931 students). Although mean WBLT usage is significantly ($P < 0.001$) higher for students attending a minority rather than a majority of face-to-face lectures (46.2 % compared to 31.5 %), in both cases there are students using the full range: from none (0 %) to all (100 %) of available WBLT.

Mean WBLT use is also significantly ($P < 0.001$) higher amongst ESL students: 42.3 % compared to 35.4 % for native English speaking students (Table 3). This difference is primarily due to the lower proportion of ESL students using no WBLT (19 % compared to 28 %) however variation in WBLT use varies considerably from 0 to 100 % for both groups (Table 3). This high use of WBLT by ESL students does not, however, occur with face-to-face lectures. Mean face-to-face lecture attendance is 62.8 % for ESL students compared to 64.1 % for non-ESL students, a negligible difference that is not statistically significant ($P = 0.510$). Similarly, mean WBLT use depends significantly ($P = 0.008$) on employment status, but rising from 33.9 % for students not working to only 42.3 % for students working full time. Mean face-to-face lecture attendance decreases significantly ($P < 0.001$) from 69.1 % for students not working to 63.0 % for students working part-time and 58.0 % for students working full-time.

Student effectiveness of WBLT and face-to-face lectures

Table 4 provides the percentage of students providing each of the five Likert scale responses from strongly disagree to strongly agree, together with the number of students

Table 3 WBLT utilization rates within student subgroups

WBLT use	0 %	10 %	30 %	50 %	70 %	90 %	100 %	N	Mean (%)
Non-ESL	28	17	16	12	12	7	8	1115	35.4
ESL	19	15	18	17	14	9	9	399	42.3
Not working	27	19	18	12	9	8	6	425	33.9
Part-time work	26	16	15	13	15	7	8	829	37.7
Full time work	20	16	17	15	12	8	12	256	42.3

Table 4 Students' perceptions of learning helped by WBLT and face-to-face lectures

	SD (%)	D (%)	N (%)	A (%)	SA (%)	N	Mean
WBLT made it easier for me to learn	8	8	24	38	21	1527	3.56
Face-to-face lectures made it easier for me to learn	3	8	22	36	31	1526	3.83

SD strongly disagree, *D* disagree, *N* neutral, *A* agree, *SA* strongly agree

answering each question and the mean response. While 59 % of students agreed or strongly agreed that WBLT helped learning the corresponding value for face-to-face lectures was 67 %. Neither of these questions was significantly ($P > 0.05$) related to student ESL or working demographics.

Student monetary valuations of WBLT

Summary statistics for the monetary valuations of WBLT are provided in Table 5. Only 10 % of students place no value on WBLT in the sense that they are willing to lose the rights to access WBLT without any discount on fees. We can be confident these students place no value on WBLT because they are voluntarily willing to give up any future access to WBLT without anything in return. This distribution is highly skewed, as indicated by the significantly higher mean ($207.7) compared to the median ($100). That is, while most students place low monetary values on WBLT a few have extremely high valuations. A quarter of the students require at least $200 in compensation should WBLT no longer be available. The download fees show similar trends, although 41 % of the students were unwilling to pay any download fee to access WBLT and only 25 % of the students were willing to pay $20 or more per unit per semester. The last two columns of Table 5 indicate that, while there is a tendency for students to place a higher monetary valuation on WBLT, when they use WBLT more often or agree that WBLT makes it easier to learn, the strength of this relationship is weak with Spearman correlation coefficients less than 0.2.

Some students indicated that they expect WBLT to be provided and considered that they had already paid for these in existing fees. Other students indicated that they appreciated WBLT were free, suggesting students do not appreciate the opportunity cost of having access to WBLT. Although students are not paying directly, WBLT requires university resources, including the time of their teachers, which may otherwise have been allocated to more effective teaching. Nevertheless, a minority of students are willing to pay substantial amounts to download WBLT, leading to an average of $22.50 per unit per semester.

Table 5 Summary statistics for the quantitative valuations of WBLT (opportunity cost)

To access WBLT	0 %	Min	Q1	Median	Q3	Max	Mean	N	Use	Learn
Discount	10	0	50	100	200	1000	207.7	1401	0.10	0.09
Download fee	41	0	0	5	20	500	22.5	1475	0.17	0.18

Percentage of students responding with zero and the minimum, first quartile, median, third quartile, maximum and mean valuations of WBLT (in dollars per unit per semester). The last two columns are the Spearman correlation coefficients with "WBLT use" and "WBLT made it easier for me to learn" (all $P < 0.001$)

The download fee was not significantly ($P > 0.05$) related to the ESL and working demographics. The discount was also insignificantly related to ESL, however it was significantly ($P < 0.001$) related for working students. Students not working have a median (mean) discount of \$2 (\$20) compared to \$10 (\$28) for students working part-time and \$10 (\$25) for students working full-time. Thus students with ESL provide similar valuations of WBLT, and there is mixed evidence that working students provide slightly higher valuations.

Staff and student qualitative results

90 per cent of student respondents answered the free text question concerning how they would be affected if WBLT were not available. Thematic analysis from the student qualitative data revealed several themes with 34 % of students unaffected if WBLT were not available, 14 % affected but without specifying a reason, 23 % affected by their ability to review material, 13 % who utilised the flexible learning made available by WBLT and 6 % who used WBLT as a backup if they could not attend individual lectures. The relatively high 34 % of students indicating they would be unaffected if WBLT were not available is consistent with the 41 % of students unwilling to pay to download WBLT (Table 5), but perhaps surprising given the high average download fee of \$22.50. This result occurs because many students give no value to WBLT, but a few students consider them essential and provide very high valuations. This raises an equity issue that we return to later in the discussion.

Thematic analysis of the academic staff interview data revealed three themes: views on the student advantages of having access to WBLT; the impact of WBLT on their teaching style; and concerns about the impact of WBLT on student learning behaviours. These are explored in relation to student survey comments below.

All staff considered the greatest advantage and main purpose of WBLT for students was the review of lectures. This was the most common reason students gave for how they would be affected if WBLT were not available.

> I find iLecture incredibly valuable, I use it frequently to reinforce message even though I attended all but one lecture[sic].(Verbatim Student Statement).

Flexible teaching approaches for students with complex lives involving study, work and family was mentioned by many students and all interviewed staff. For example, students reported they would be affected in the following ways if WBLT were not available:

> It would mean I would have to change my work schedule in order to accommodate, as normally if I'm working I can catch the lecture later. (Verbatim Student Statement).

> I found iLectures very helpful to revisit concepts and manage my study load around work. If they weren't available I would have to cut my hours to fit around face to face lectures. (Verbatim Student Statement).

> As I have to travel a long way to uni it means I would be at uni up to four days a week and hence unable to work. (Verbatim Student Statement).

Often these comments indicate an inconvenience rather than a complete barrier to learning but explain why some students provide a relatively high monetary valuation on WBLT. There can be a direct financial cost in terms of work and travel that must be offset if WBLT are not available.

Universities use WBLT as a way to promote education to members of our society who may otherwise be subject to insurmountable barriers. Although WBLT was introduced to the university as part of its disabilities services, no teaching staff mentioned this when asked for the student advantages of making WBLT available. Staff instead focussed on the more common advantage to students with work and family commitments. Despite the high numbers of students with ESL at the university (60 % in the Business School), only two teaching staff mentioned the benefits of WBLT to students with weak English skills.

Some students expressed high regard towards WBLT but without any regard for the opportunity cost involved.

> I didn't actually use it. But I thought I would, and I'm glad they have the option. (Verbatim Student Statement).

The students indicating they would not be affected if WBLT were not available provide a more balanced perspective on the opportunity cost of WBLT.

A preference for face to face learning experiences was one of the few reasons given by students as to why they would not be affected if WBLT were not available.

> It wouldn't have a great effect as I believe face to face lectures are more effective. (Verbatim Student Statement).

Student preference for live lectures which are interactive, motivating, stimulating and well-structured has also been observed in previous literature (Copley 2007; Gosper et al. 2007). Thus any detrimental effect on face-to-face lectures by the provision of WBLT should be viewed as a significant cost of WBLT. Staff interviews together with the responses of their students provided several insights here.

Some teaching staff embraced the capacity of the software to deliver tailored online learning resources however their efforts appear to have been ineffective. All staff interviewed were frustrated that students complained if a reasonable quality recording of the lecture was not available. Students appear to appreciate attention to quality.

> The iLectures for this unit were engaging and positive. iLectures for other units at times are terrible. So overall iLectures are only beneficial if appropriate respect is given to them by lecturers. (Verbatim Student Statement).

This attention to quality was discussed by a teacher who monitored the quality of the audio recording rather than devoting resources to WBLT. In contrast, another teacher spent 1 hour a week creating a Camtasia software index to the WBLT for uploading into Blackboard™ because they considered it 'aids the review function'. Student agreement with the value of WBLT and face-to-face teaching in this unit were very close to the mean, suggesting the time spent 'upgrading' WBLT does not significantly increase student WBLT usage and perceptions of value to their learning.

Four staff felt that WBLT had a negative impact on their face to face teaching. These staff felt constrained by WBLT; they were more mindful of their language and did not use the white board to illustrate because there is no video. Most common amongst this group were issues with microphone failure, which had forced them to reduce their interactivity with students in order to use the most reliable microphone at the podium. Most of these staff used the system as a backup recording of their transmissive face-to-face lecture. A number of these staff expressed concern that provision of WBLT may result in students viewing the resource as a replacement for attending lectures. These staff perceived inferior face-to-face lectures as an opportunity cost from providing WBLT.

The interviewed teacher who did not use WBLT did not deliver lectures but emphasised student/teacher dialogue in their seminars. The microphone only captures the teacher component and so they considered WBLT inappropriate. This teacher believed that creating some short 10 min 'snappy packages' on WBLT could supplement the seminar but the lack of easy editing and therefore the time impost was a cost that was too high to justify the benefit.

Discussion and conclusion

From the perspective of a teacher, this estimated download figure of $22.50 per student per unit translates into a total of over $10,000 for a class of 500 students taking just one unit in one semester. Academic staff are likely to provide WBLT if they know it is so highly valued by their students. Indeed, staff are likely to provide WBLT if in return they receive even a fraction of this amount as a small research or teaching grant. From a university perspective, the university estimates that it spends approximately $500,000 per year providing WBLT equipment, software and technical staff. At an estimated download figure of $22.50 per student per unit, this requires approximately 2400 full time students in order for the student estimated value of WBLT to exceed costs. Therefore, these crude estimates of costs and benefits suggest the provision of WBLT is worthwhile for a university. There are, however, several reasons why this result must be interpreted with caution.

First, this university cost of providing WBLT covers only the basic running costs. In particular, it assumes teaching staff allocate none of their time to WBLT. For example, suppose a teacher spends 30 hours per semester on WBLT (considering implications of WBLT to overall unit design, designing and reviewing WBLT materials, answering student WBLT related questions, etc.). Then at $50/hour a total of 67 students with an average valuation of $22.50 are required in the unit to cover this cost. Our interviews with teachers found cases where teachers spent considerably more time than this and cases where teachers had already decided their time was better spent elsewhere.

Second, these calculations use self-reported valuations by students and represent their intention to pay rather than what they would pay should download fees be introduced. For example, the results show that only a quarter of students state they would pay a download fee of $20 (or more). Thus, if a fixed download fee of $20 was introduced WBLT provision may be a loss making enterprise.

Third, this average of $22.50 hides the result that most students place little or no value on WBLT while a few place very high values on WBLT. Thus the value obtained by providing WBLT is obtained by a very small minority of students. This raises important equity issues concerning the provision of WBLT. If this small number of students were removed, WBLT is unlikely to be cost effective. The question of whether a few students should be subsidised by the majority is an important equity issue not explored fully in this

paper, however results show that the student demographics of ESL and working do not adequately describe this minority.

Fourth, staff interviews identified additional opportunity costs such as WBLT resulting in lower quality in the more valuable face-to-face lectures. Strong student demand for WBLT capture of face-to-face lectures is inadvertently driving didactic teaching methods, such as teachers remaining at reliable microphones behind podiums. This observation that web-based lectures reinforce a teacher-centred delivery model has been noted (Phillips et al. 2007; Sheely 2006 cited in McNeill et al. 2007). Furthermore, students reported that face-to-face lectures were significantly superior to WBLT in terms of both usage and assisting student learning. Despite encouragement by the university for all staff to provide WBLT, one teacher who eschewed the technology, evaluated the opportunity costs of doing so and has maintained relatively high quality face-to-face teaching without diverting their time from other important activities such as research. The majority of students surveyed and all the teaching academics interviewed did not view WBLT as a replacement for face to face teaching but as a supplement and backup resource for learning. This highlights Chang's (2007) view that university policy outlining the use of WBLT should not be prescriptive. This would support teachers in their choice of delivery model that they felt was the best fit for their unit and student cohort.

This research adds to previous research using self-assessment of student usage and effectiveness of WBLT by contrasting this with corresponding evaluations of face-to-face lectures and with the addition of monetary valuations of WBLT, student comments and interviews with teachers. These all suggest WBLT has significant opportunity costs that university administrators, teachers and students should not ignore. While WBLT are considered a useful resource by both staff and students, this resource is acceptable at the simple level of a quality audio and only to a small number of students. The time spent by teaching staff to enhance WBLT, without evidence of benefit to student learning, might be better spent in other ways that inform their teaching and or research.

Implications for higher education

This case study of WBLT has implications for resource allocation at both individual universities and for the higher education sector generally. Universities need to be mindful of the opportunity cost of promoting teaching support technologies that take time and resources from academic staff. This is especially pertinent if the teaching-research nexus is believed to benefit both students and university, as staff encountering increasing research expectations and higher student/staff ratios may be able to use these resources to better advantage.

Many universities promote flexible learning and blended learning models to students without professional development programs to assist staff. If WBLT are used merely as an 'add-on' and are not part of a curriculum approach then anytime spent on enhancing WBLT recorded face-to-face lectures may be inefficient. Indeed, the opportunity cost of enhancing WBLT could be substantial if this is in place of curriculum design. Good curriculum design should drive approaches to teaching and learning rather than technology.

The provision of WBLT is not cost effective for most students, especially when the opportunity cost of doing so is taken into account, but it is very cost effective for a relatively small number of less traditional students. While there may be a strong case for society to provide access to education for equity groups the need for individual universities to all do so is weaker. There is debate about the position of universities in the Australian

higher education market and the need for universities to find ways to differentiate to attract students in a deregulated market. Should all Australian universities be aiming to provide all modes of teaching delivery, using similar technologies? Currently this ranges from specifically catering to distance education students who never or rarely are on campus to flexible delivery where campus-based students are provided with facilities such as WBLT so that they can complete their studies despite missing classes due to work or family commitments. Our study questions this uniformity of provision of university services in Australia in contrast to the UK where distance education is dominated by a single provider (Open University). Would Australian education be superior if one (or a few) universities specialised in distance education services while others specialised in traditional face-to-face delivery? This would reduce opportunity costs associated with each university attempting to provide a diverse variety of educational options rather than concentrating efforts on the services their particular students' desire. For example, if most students at a traditional university prefer quality face-to-face instruction then why not concentrate on providing superior face-to-face delivery rather than diverting resources to other delivery methods such as WBLT that the students consider inferior? While the provision of simple audio recordings may be cost effective, more extensive effort, especially in terms of academic's time, may not be.

Further research is required in several areas. First, the identification of the small minority of students placing significant value on WBLT is required if these students are to be assisted efficiently. Simple but accepted stereotypes such as ESL and working students are inadequate. Second, future research may be advised to avoid valuations of WBLT unless opportunity costs are obtained. For example, this study benchmarked the value of WBLT against alternative services such as face-to-face lectures and obtained monetary valuations. It also showed that students providing higher monetary valuations do not necessarily use WBLT more or get more benefit from them. Third, this methodology can be applied to the provision of other student services. Finally, research is required into alternative models for higher education, including whether niche universities providing services tailored for specific students, is preferable to a model where all universities cater for all students.

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