

From how to why: Student experiences of a university's technology-enhanced learning over 5 years

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This is a longitudinal case study of student perspectives on Western Sydney University's strategic initiatives to promote technology-enhanced learning (TEL) from 2012 to 2017. The study analyses data from students throughout this period, and includes consideration of how the student experience is being shaped by academic and institutional support for TEL. Initially the University focus was on use of mobile technologies and 'blended' learning environments; as a platform for transforming pedagogy. In 2013, teaching staff and new undergraduate students were issued with tablet devices. As well as investing in the devices and supporting campus infrastructure, the institution also provided additional support for curriculum and staff development. For two years, students' feedback about the tablets was overwhelmingly positive about their value for learning. In 2015, most undergraduates had tablet devices and TEL was becoming business as usual. However, the evaluation feedback that year showed that use of tablets had begun to decrease and there was a corresponding increase in use of smartphones. For some activities, laptops were preferred. In 2016, multiple types of device were issued to students, with some disciplines choosing laptops and in 2017 the University provided free digital textbooks instead of devices. Students' use of different devices for learning activity has been shifting and evidence gathered internally from students and staff has played a role in adapting to this. While TEL strategies differ between universities, the analysis provides an example of how systematic evaluation evidence can support systemic adaptation as the learning technology environment changes.

Background and context

In late 2012, the senior management of Western Sydney University took a strategic decision to invest in substantially enhancing the use of digital learning technologies. The University has a higher than average proportion of students from low socioeconomic status backgrounds. It has six campuses across a region of culturally diverse and growing population. Students (and staff) often travel a long way to reach campus classes. Many students have paid work and family responsibilities while studying. So there are clear advantages in providing flexible learning options through access to digital activities and resources. As a key part of the digital learning strategy, the University decided to issue all new undergraduate students with a tablet device.

Accompanied by expanded campus wireless coverage and network capacity, these lightweight portable devices immediately gave new students easy access to download digital learning resources from any campus location, and to use them anywhere. A significant proportion of new students had no access either to a laptop or tablet. Others who had access to a laptop at home would be unable to

bring it to campus. Lectures were already being recorded automatically and provided online. The Library was making digital readings available. There was growing use of the online learning management system, and widespread use of its basic functions. Until the tablet issue, many students would have to find a space at a desktop computer in a library or computer lab to access these digital resources and activities.

In 2012 the strategies and their rationale was only broadly defined in strategic planning documents; in terms of providing flexibility for students and with an intention to evaluate the pedagogy in more detail, for example:

Enable students to study in their own time, supported by ICT-enabled learning resources

... develop a suite of blended learning options within each course evaluated for effectiveness and mode of implementation, including online capability

... to ensure the most effective learning spaces are available to match the University's learning and teaching plan.



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... each School will have a blended learning plan by September 2012 for implementation from 2013.

By 2015 the institutional strategic planning documents were much more specific about the value of TEL for the curriculum, and explicitly acknowledged the need to continue adapting in a changing environment:

... will continue to provide high-quality, inclusive, diverse and technology-enhanced learning environments. It will develop greater flexibility in the types and modes of delivery in on-campus, online and blended educational programs.

Students will be able to access learning in flexible and responsive ways, including through individual and peer learning spaces on campus, in workplaces, in international settings and in virtual environments. The University will adopt new technologies to respond to the emerging needs of students and employers. The University will offer a suite of flexible approaches to course delivery

The 2015 strategic plans explicitly link the use of TEL with curriculum innovation. Initially the focus of evaluation had been on tracking the impact of technology use on the student learning experience. A study across three universities in 2010 (Gosper, Malfroy, & McKenzie, 2013)

provided a starting point. It identified three aspects of technology provision for learning: institution-led (infrastructure, learning management systems, helpdesk support etc.), academic-led (how teachers use technology with their students) and student-led (devices and activities that students choose to use for learning). There has been a dynamic interaction between these three aspect over several years. In the process, several other aspects of the University's operations also had to adapt, including the evaluation process itself.

Earlier short papers document the development of the University's internal evaluation strategy (Russell, 2014, 2015; Russell & Qi, 2013). A book chapter (Russell, 2017) describes the introduction of tablet devices as a systemic catalyst for curriculum transformation. This paper provides a longitudinal overview of all the institution's strategic TEL initiatives and includes analysis of evaluation data from 2016. It traces the development of the University's strategic positioning of technology-enhanced learning. While the data presented and the analyses focus on using technology to enhance the student learning experience, and on the associated curriculum development work, the interactions with, and changes in, other aspects of institutional support are also described – the bottom three levels shown in Figure 1.

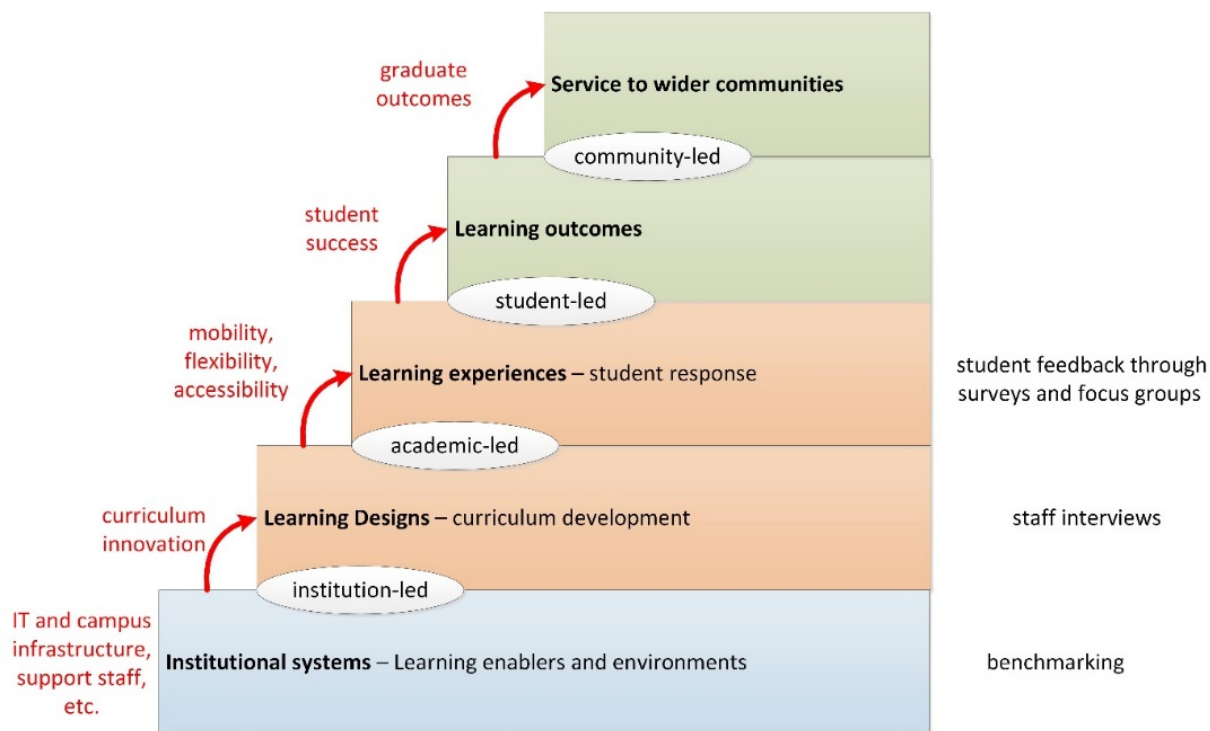


Figure 1: A conceptual model for evaluating institutional TEL support

Theoretical approach: complex adaptive systems

Barnett (2000) describes the ways in which universities are complex systems operating in a super-complex environment. Learning and teaching in universities is multi-dimensional and dynamic. There are diverse cultures and practices. Decisions and processes affecting the development of the whole system happen at multiple levels, from senior executives to individual teachers and students within each discipline. An international study of how large diverse organizations adapted to technological and other changes in the 1990s explains the adaptive process in terms of complementarity theory, which draws on mathematical game theory (Pettigrew & Massini, 2003). Any organizational system with distributed decision making, such as a university with devolved discipline-based planning systems, will have complementary subsystems that cannot be changed in isolation. Attempts to introduce a new technology or a new process without changing any of the complementary subsystems will usually fail. The other subsystems, especially if well established and optimized for the status quo, will suddenly become sub-optimal and will fight the change to protect their own operations.

This explains some of the continued resistance to technology-related change in university teaching practices (Hiew & Chew, 2016). Russell (2014) provides a specific example where resistance to the introduction of 'blended learning' among academic staff was based on a perception, and in some cases the reality, of academic teaching workloads being measured solely in terms of time teachers spend in the classroom. Some teachers believed that if they shifted a proportion of their teaching to online mode, this would not be counted and they would be allocated yet more teaching work. Changing other subsystems such as those for defining, measuring and planning teaching work is needed as well as curriculum development support and technology provision.

The analysis of student perspectives on institutional change around introduction of TEL initiatives is framed as such an adaptation process. It tracks student responses as TEL strategies developed and adapted to a changing environment. While the focus is on the student learning experience, there is also a need to analyse how the developing institutional systems and learning designs are supporting student learning.

Evaluation strategy

Scope and focus

The ACODE benchmarks provide a framework for further clarifying the scope and focus for evaluating institutional support for TEL. The 8 benchmarks cover:

1. Institutional policy and governance
2. Institutional planning and quality improvement
3. IT systems, services and support
4. Application of TEL in the curriculum
5. Staff professional development
6. Staff support
7. Student training
8. Student support

The main focus of this study is on the application of TEL in the curriculum, and on how this shapes the student learning experience. However, the University is a complex and highly interconnected system, where there are devolved decisions about discipline curricula supported by institution-wide infrastructure, policies and organisational processes. So even though the key evaluation questions centre on the student experience, it is necessary to consider other influencing factors. Qualitative analysis of the student comments from the 2010 survey cited above showed that students were often dissatisfied with their teachers' ability to use technology effectively to support student learning (Russell, Malfroy, Gosper, & McKenzie, 2014). Broader studies have reflected a similar pattern. A later US-based international study (Brooks, 2016, p. 6) noted that:

In addition to infrastructural considerations (i.e., reliability of Wi-Fi, network performance), students' technology experiences are shaped by their perceptions of the adequacy of their instructors' technology skills, their attitudes toward technology, and their belief that technology used in class will benefit them in their chosen careers.

Methodology and methods

The overall methodology for this longitudinal study is framed as action research, a well-established approach for evaluation in higher education, both at the level of individual practitioners and for institutional change (e.g. Bhattacharya, Cowan, & Weedon, 2000; Laurillard, 2008; Trevitt, 2005). Kemmis (2010) explores how action research shapes history by changing what is done. This longitudinal study is looking at the recent history of one university, through the lens of changing annual evaluation data from students and staff experiencing technology-related change in how they learn and teach. Action research involves cycles of action, planning, implementation and reflection on outcomes. For each year after 2012, there were cycles of gathering information, which varied depending on the main initiatives (and resources available) that year.

This was a mixed method study (Cresswell, 2009), collecting both quantitative data to identify broad patterns and qualitative data to find out about some of the underlying mechanisms and changes.

Table 1: Action research cycles aligned with institutional support initiatives

Institutional initiatives	Evaluation methods used
<p>2013 Initial issue of tablets to new undergraduate students and permanent teaching staff. Institution-wide program of support for use of mobile devices, focusing on use in 1st year undergraduate classes initially Educational design support teams placed in disciplines.</p>	<p>Survey of all 1st year UG students, asking questions on device use and technology-enhanced learning (TEL) activities. Focus groups with a cross-section of 1st year undergraduate students. Interviews with a cross-section of staff teaching 1st year classes and/or preparing for teaching 2nd year in 2014.</p>
<p>2014 New undergraduate students again issued with tablet devices, and some also provided for sessional staff. Continued support for use of mobile devices and for educational design, including all study levels, centrally and within disciplines Investment in infrastructure (collaborative learning spaces, informal learning spaces, enhanced network and wireless capacity) Introduction of summer terms.</p>	<p>Survey of 1st and 2nd year UG students on TEL Additional survey questions (for all undergraduate students) requested by students on preferred study modes and flexibility needs. ACODE benchmarking: using benchmarks 1, 4 and 6.</p>
<p>2015 New strategic plan for 2015-2020 emphasises the student-centred goal, and clarifies the role of TEL in this Continued funding for discipline-based educational design support for further 3 years Continued enhancement of campus learning spaces and IT infrastructure. More fully online programs.</p>	<p>Survey of all UG students on TEL Interviews with a cross-section of staff similar to 2013 (including some previous interviewees for direct comparison of change) Student survey data available on institutional dashboard, with text analytics on comments.</p>
<p>2016 Disciplines choose which devices are issued to new students Pilot of new Learning Studios for a new campus.</p>	<p>Revised shorter survey focusing on how students were using each of their devices. ACODE benchmarking: using benchmarks 3, 4 and 8</p>
<p>2017 Instead of devices, students are all provided with free digital textbooks. New campus opened, with Learning Studios, no lecture halls.</p>	<p>Revised routine surveys on study units introduced, with question on TEL use. Learning Studio evaluation underway.</p>

The qualitative methods showed why students and staff were responding in particular ways to the introduction of TEL. Table 1 lists the annual cycles, showing the main institutional initiatives each year to support TEL and the evaluation methods used that year.

Quantitative responses to survey questions were displayed graphically in reports and in 2103 and 2014 there was also a statistical analysis to find out whether there were any significant differences between disciplines in the responses. Qualitative data from survey comments, student focus groups and staff interviews were analysed thematically using NVIVO software. However, in 2015 the text analytics programming used to identify themes in the student comments routine student surveys was updated to search for new vocabulary around technology enhanced learning (drawing on earlier manual thematic analyses for this project). The results presented below are primarily the quantitative responses to multiple choice questions tracked across several years, along with data from student focus groups. A full description and analysis of the large volume of qualitative data from the survey questions will require a separate paper. However, to aid the analysis, a short summary of results from student

focus groups and staff interviews is included, as is information from the ACODE benchmarking of institutional TEL support.

Results

The results of the study are presented here as a chronological summary of information gathered on the student experience. Also included are overviews of the academic and institutional perspectives to support an analysis of the student experience that includes the three lower levels in Figure 1.

Student experience

Student focus groups in 2013

Transcripts from focus groups with 42 first year students across different disciplines and campuses were analysed thematically. The themes identified were grouped under three categories: institution-led aspects of technology, academic-led use of technology and student-led uses of technology. Table 2 lists the number of comments coded for each of the major themes identified within each category.

Table 2: Thematic analysis of student focus group transcripts from 2013

Theme	sub-themes (most frequent 1 st)	no of comments for theme (subthemes)
Institution-led technology use		
institutional systems	Online learning management system, wifi, computers on campus	60 (23, 22, 9)
tablet advantages	Accessibility, flexibility and mobility, portability	34 (14,11,8)
tablet disadvantages	incompatibility	22 (17)
Academic-led technology use		
teacher use of technology	video recordings and podcasts	42 (9)
teacher use of tablets	tablets in class, for content delivery, general usefulness	33 (11,6,6)
problems with teacher technology use	poor teacher skills, prefer classroom to online	22 (17,5)
Student-led technology use		
use of tablets	Notetaking, watching lecture recordings or live lectures, email, reading, Facebook for learning, organise study schedules, storing of learning materials, online quizzes, group work, classroom work	200(31,27,27,26,22,17,12,12,7)
use of other devices	where students don't use tablets, syncing files between devices, laptops, campus computers, file sharing with others, smartphones	99 (50,19,15, 10, 8,6)
discipline-specific technology use		42
students' own technology skills		14

2013 student survey

The survey run in 2013 used a subset of the questions used by Gosper et al. (2013), so that responses from this university could be compared with those in 2010. In this survey, first year undergraduate students were asked not only how often they used a range of technology-enhanced learning activities and technological tools, but also which type of device they used to access these. There were also some additional questions about the perceived value of the tablet devices they had been issued with. There were 740 responses, around 6% of the total population invited.

The responses to the questions about tablet use indicated that most students who have tablets were using them in all of their study units. They believed that the use of mobile technologies in their study help both their learning and their future careers. Many also believed the tablets helped with collaborative work. However, teacher use was variable. Some teachers were running activities in which students use tablets daily or weekly, while others are not using them at all.

The survey asked students how often they took part in 15 different online learning activities as a required part of their course of study. The most frequent activities were accessing Library resources, podcasts/vodcasts created by teachers, and social networking/sharing websites, with many students accessing these at least several times a week.

There was a difference in the devices they are using for these activities. Tablets were by far the most commonly used device for all activities except accessing library resources and creating web pages, where laptops or desktops were more often used. In questions about use of the online learning management system tools, again the tablet was the most frequent access device, apart from assignments and quizzes, which stood out as mainly done on laptops or desktops.

The survey also asked about use of online communication tools for study. Compared to 2010, students were using email much less in 2013, and had moved to social network sites, messaging and chat for communication with each other.

Comparison between disciplines showed some significantly different responses to question on teacher use of tablets, and on teachers' levels of skills with technology. In one case higher use and better teacher skills could be traced to a group that had issued teachers with tablet devices a year earlier than the rest of the University. In another there had been a new curriculum that had completely replaced large lecture classes with online activity, and had only small group tutorials and practical work.

2014 student survey

The same survey questions were used in 2014, and extended to both 1st and 2nd year students, to reflect the

fact that the majority of both cohorts had been issued with tablets, and the curriculum changes were being rolled out to higher years. This time there were extra questions requested by student representatives, on preferences between fully online, face to face or blended study modes. There was also a question on what 'flexibility' means for students. All undergraduate students were invited to respond to the additional questions and there were 3141 responses, representing about 10% of the undergraduate population.

The responses on preferred study modes were ambiguous, in that there was a significant overlap from those responding positively to the 'face-to-face' only option and also the 'online only' option. Thematic analysis of the comments on flexibility gives some insight. The themes on flexibility were of two broad types: reasons for needing flexibility and types of flexibility. Paid work was the most frequent reason given for needing flexibility. Other comments mentioned time management in general or family responsibilities. The types of flexibility sought are consistent with the multiple choice responses, in that availability of both face to face and online options and ability to study any time were the two most common themes.

In the main survey for 1st and 2nd year students, the responses were broadly similar to those in 2013, apart from the fact that this time there were no significant differences between discipline groups, with previously lower groups now showing greater use and teacher skills with technology.

2015 student survey

In 2015 all undergraduate students were invited to complete the core survey questions (i.e. excluding those about study modes). This time there were 2366 responses, representing 6.3% of the total undergraduate population.

Figure 2 shows a summary over 3 years of the frequency with which 1st year students report using various types of online learning activity. Figure 3 shows the corresponding data on the devices used for these activities. While the use of online resources from the Library has increased, use of other online activity has decreased. The reduction in tablet use for study activities is mirrored almost exactly by an increase smartphone use (Figure 4).

The quantitative results are summarised in Figure 5. They show that students are using computers and smartphones more than tablets for daily study activities, and particularly for accessing the LMS. It also appears that most of the online activity is taking place through the LMS. Tablets and smartphones are still preferred for access to information, while computers are preferred for online and creating activities. For collaboration, phones are dominant.

2016 student survey

In 2016 the survey questions were reconfigured to shorten the survey, combining the various detailed lists of online learning activity types into four categories: accessing information, online activities, collaboration and creating. The shorter survey took about 5 minutes (rather than the previous 10 minutes) to complete and this time there were 3793 responses, or 10% of the population.

The quantitative results are summarised in Figure 5. They show that students are using computers and smartphones more than tablets for daily study activities, and particularly for accessing the LMS. It also appears that most of the online activity is taking place through the LMS. Tablets and smartphones are still preferred for access to information, while computers are preferred for online and creating activities. For collaboration, phones are dominant.

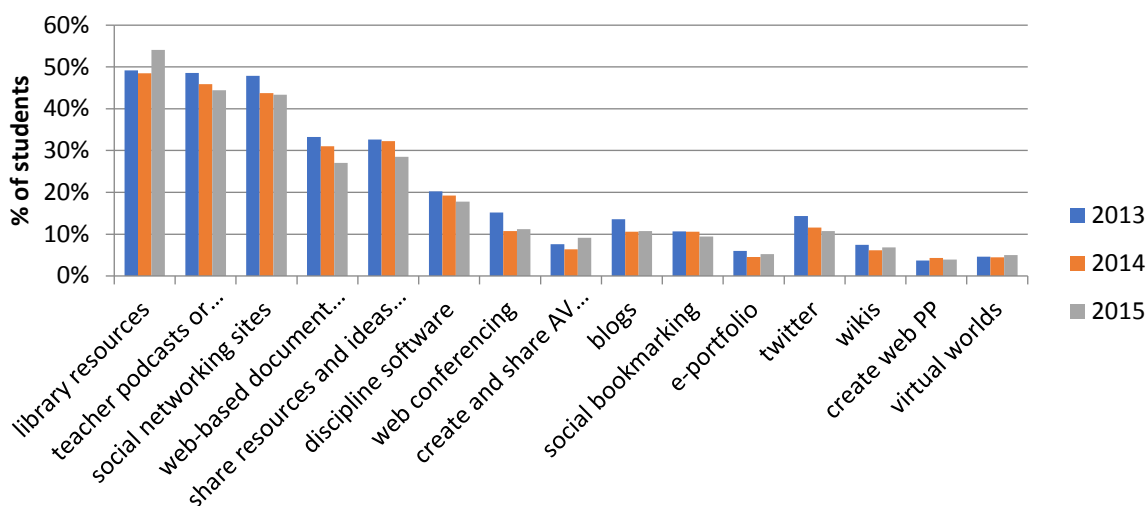


Figure 2: Percentage of 1st year students reporting use of different online activities at least a few times a week

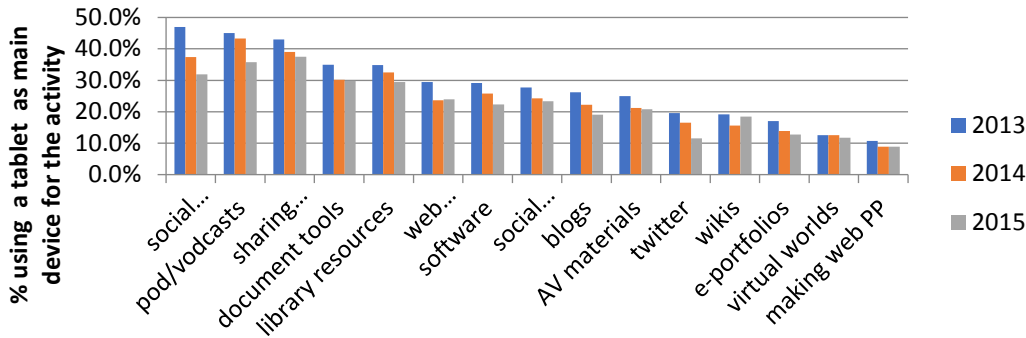


Figure 3: Tablet use for various study activities: changes from 2013 to 2015

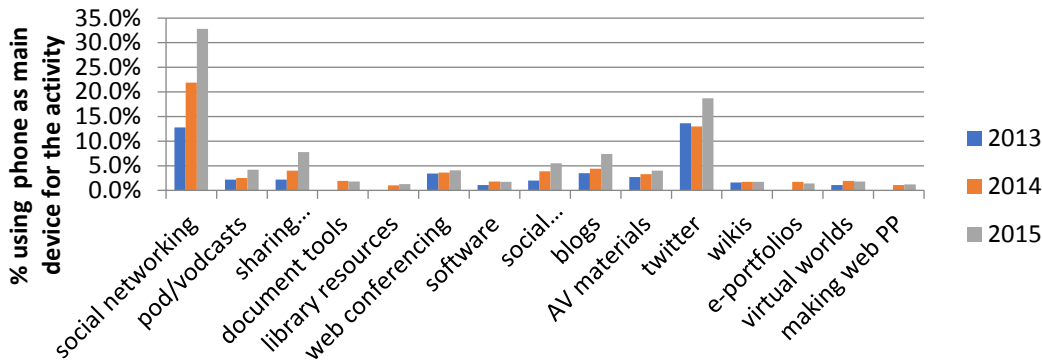


Figure 4: Smartphone use for various study activities: changes from 2013-2015

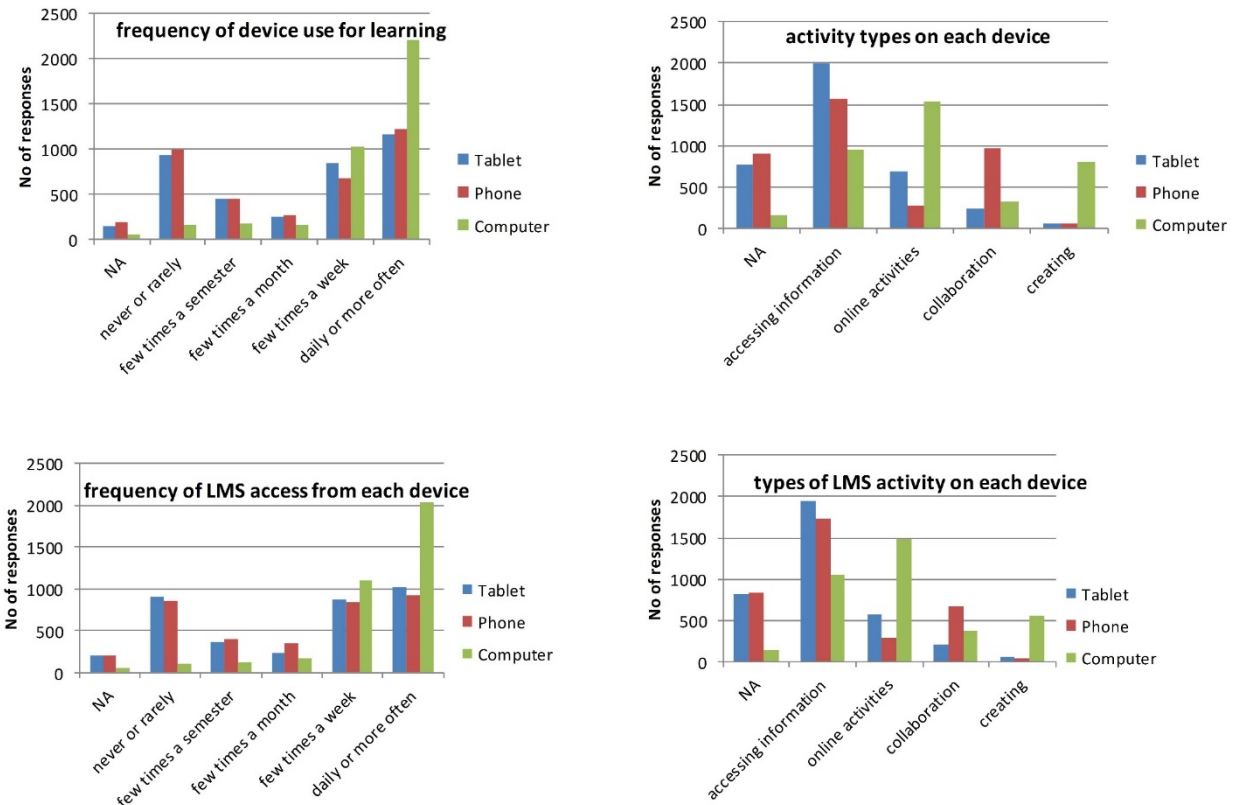


Figure 5: Device use for study activities (upper graphs) and accessing the LMS in 2016.

2017 student surveys

During 2016 there was a review and redesign of the standard student feedback surveys for study units. The questions were updated to match current approaches to teaching and educational design. The survey has been shortened and simplified, with the aim of improving response rates, and launched on a new software platform. The new survey was introduced at the beginning of 2017. One aim of the redesigned questions was to clarify feedback on the learning designs in each study unit, including use of technology. This may obviate the need for separate TEL survey questions, as mining of the large volume of data available from other routine surveys is now feasible.

Academic and institutional support for TEL

Academic perspective

Data on the changing perspectives of academic staff came from total of 19 semi-structured interviews with staff in December 2013 (end of the first year of the Blended/mobile learning strategy) and in mid-2015 (final year of the 3-year program). The data was analysed thematically under the same three categories as used for the student focus groups shown in Table 2 above: institution-led, academic-led and student-led technology use. Between 2013 and 2015 the academic-led themes shifted to show a greater emphasis on learning activity design and evaluation. Discussion of the impact of summer terms and fully online is also more frequent in 2015.

The analysis reflects a shift away from focusing on tablets (as a device) and staff development between 2013 and 2015. There are also fewer references to (external) curriculum development drivers and more to school-based support. This, and a rise in references to specific software and infrastructure services, may be related to the increased focus on designing learning activities. In other words, the results of the thematic analysis are consistent with a shift from individual teaching activities and devices to teamwork with support staff on learning designs using institutional tools. Staff reports on student activity have changed little except that the 2013 perception of students' lack of IT skills had disappeared in 2015.

Comparison of how repeat interviewees discussed the same themes in 2013 and 2015 reflects a more assured approach to teaching with technology, both online and with mobile devices in class. Staff development and school based support are being used to good effect, but are not always accessible. In 2015, both the summer terms and fully online options are driving curriculum change in campus-based semester teaching. However, teaching staff are still adjusting to the workload and skills

involved. One continuing challenge is finding time to develop skills and practices further.

Institutional perspective

The ACODE Benchmarking exercise in 2014 confirmed that the university had a clear strategy for TEL support (benchmark 1) and was making progress on integrating effective technology use with curriculum development (benchmark 4). However, the review of staff support (benchmark 5) suggested that further evaluation of this would be useful. In 2016 the choice of benchmarks reflected the new strategic plans, and in particular the renewed and more explicit focus on providing a technology-rich and effective student learning experience.

The introduction of summer terms in 2014-15 (shorter and in many cases making more intensive use of the online environment) provided an additional impetus for redesigning the standard semester to include more blended study modes. Educational design support teams were able to help with this. Also during this period there was an institutional program to introduce fully online programs for distance/external students, as a separate initiative. While these programs are not directly experienced by the majority of the students, who were studying on campus in blended mode, some of the academic staff were teaching across the different modes.

An institutional strategy review in 2015 consolidated and clarified senior level commitment to continuing support for TEL. This was reflected not only in some specific strategic objectives, but also in continued funding for discipline-based educational design support teams.

By 2017, there had been a further shift in priorities, with the provision of new learning spaces – embodying the use of technology supported collaborative learning in the structure of new buildings. During 2016, pilot learning spaces for a new campus drove curriculum change to accommodate a shift away from lectures and towards greater use of technology-rich collaborative learning. Discipline-specific evaluations showed how these spaces could support new types of learning activity (e.g. Shrestha, Wang, & Russell, 2016). In 2017 there is a new institution-wide curriculum renewal project, aiming to simplify study pathways and clarify links to 21st century employability.

At the time of writing, a new institutional survey policy is being developed, to promote better use of data from institutional surveys and reduce the number of student surveys. It is hoped this will both improve data management and analysis and increase student response rates for institutional surveys.

Analysis and conclusions

The student feedback data over the five years covered in this study shows that the issue of tablet devices clearly worked well as a stimulus for curriculum innovation and a shift away from traditional classroom focused teaching practices towards use of online media for delivering information and more active work in class. However, the devices themselves became less important as the technology landscape shifted. More and cheaper tablet devices appeared on the market and smartphones became smarter and bigger. The trend to greater use of smartphones for learning is part of an international pattern in which students have access to multiple devices. The ECAR study in 2016 (Brooks, 2016, p. 6) noted that:

Laptops continue to be the academic workhorse for students. Academic usage of smartphones by students increased by 9 percentage points since 2015, but tablet usage continues to decline. ... but wearable technology ownership more than doubled in the past year.

This longitudinal review of student feedback, has linked the student experience with associated academic and institutional changes that accompany each cycle of evaluation. It shows that considerable and continuing effort and resource are being dedicated to continued adaptation; to keep up with changing use of the available technologies by students. The provision of devices was a kick-start, but the devices themselves, and the accompanying IT systems (the 'how') have become less a focus of attention than the 'why', or the curriculum transformation. The evidence shows that students are now using multiple devices in different ways, and that one of the main uses is still to access information for study. Provision of free academic digital information sources has replaced provision of access devices. Technology-rich campus environments are promoting shifts towards more active learning models. Student use of technologies for learning is continuing to evolve.

For the University, continued adaptation to new learning technologies is becoming 'business as usual'. This is also reflected in the move towards evaluating TEL through the mainstream student surveys, rather than running separate surveys. Western Sydney University, like several others in Australia, would fall into the 'extra-large' category internationally. It has large-scale institutional support systems that are not always as easy to reconfigure as they might be in a smaller college. So adaptation to new technologies requires evidence to support the planning and investment required. The student experience data presented here is only one perspective on a large institution-wide systemic adaptation. The paper touches on a few of the other parts but does not fully describe them.

One clear message is that universities, especially larger ones, need continually to gather, analyse, disseminate and respond to evidence of changes in the way students are using technology to support their learning. The main challenges in evaluating and adapting university learning and teaching systems are in connecting evidence from the student experience with academic curriculum development activity. Without healthy feedback systems, the academic-led component of the technology provision will lag too far behind and become detached from students' use of technology.

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