Higher education students' use of technologies for assessment within Personal Learning Environments (PLEs)

Lynnette Lounsbury
Avondale College of Higher Education
Lake Macquarie, New South Wales

Paula Mildenhall
Edith Cowan University
Western Australia

David Bolton
West Chester University
Philadelphia, USA

Maria Northcote
Avondale College of Higher Education
Lake Macquarie, New South Wales

Alan Anderson
University of New England

Higher education students' use of technologies has been documented over the years but their specific use of technologies for assessment-related tasks has yet to be fully investigated. Researchers at two higher education institutions recently conducted a study which sought to discover the technologies most commonly used by students within their Personal Learning Environments (PLEs). A specific aim of the study was to determine which of these technologies the students used when they complete and submit assessment tasks such as assignments and examinations. Results from questionnaires, focus groups and mapping exercises are reported and the implications of the findings for developing institutional infrastructure to engage students and support their learning are highlighted.

Keywords: assessment, student use of technologies, Personal Learning Environments (PLEs)

Introduction

Students enrolled in tertiary courses typically use a range of technologies in their personal lives and for study purposes including social media, hand-held and mobile devices, software applications and online technologies; and these technologies have been documented over some years (for example, Conradie, 2014; Gosper, Malfroy, & McKenzie, 2013; Gosper, McKenzie, Pizzica, Malfroy, & Ashford-Rowe, 2014; Johnson & Sherlock, 2014). As a collection, the interplay of these technologies make up a student's Personal Learning Environment (PLE). For the purposes of this paper, the authors have used previous definitions of a PLE by various researchers (Dabbagh & Kitsantas, 2012; Fiedler & Väljataga, 2010; Goldstein & Miller, 1976) to construct the following definition. A PLE is a system, usually self-constructed, that enables learners to manage their own learning and may include technological tools, services, online resources and communities.

Higher education students' use of technologies within their PLEs influence how they engage in their university studies. Analysis of students' PLEs is useful as they are situated within and reflective of the specific contexts in which the students' learning takes place. Learning within a PLE is often informal (Attwell, 2007b); that is “unstructured learning within a structured learning environment” (Harvey, 2015). Cross (2006) describes this type of learning as “taking part in meaningful conversations, listening to and telling stories, building personal trust networks that yield advice quickly”. This is in contrast to formal learning which has traditionally being the focus in higher education contexts and is described as “planned learning that derives from activities within a structured learning setting” (Harvey, 2015). When investigating PLEs, informal learning becomes important as well as the more formal environments offered by an institution's Learning Management System (LMS) (Taraghi, Ebner, Till, & Mühlburger 2009).

Because many tertiary students' study practices are associated with assessment tasks (for example, assignments, presentations, examinations), their use of specific technologies for assessment purposes within their PLEs needs investigation. Each student's PLE generally comprises diverse and changing technologies, that are reliant upon their varied activities and purposes. As such, a research

approach which focuses on documenting the technologies used within tertiary students' PLEs may provide insight into how university educators could design relevant, contextualised courses and assessment processes that utilise students' current use of technology (Jenkins, Walker, & Voce, 2014). Curriculum design that reflects students' use of technology has been reported as being an important issue by Könings, Brand-Gruwel and van Merriënboer (2005). Use of PLEs has also been associated with supporting self-regulated learning practices (Dabbagh & Kitsantas, 2012), learner empowerment (Drexler, 2010) and students' participation in learning and teaching processes (Attwell, 2007a). Since many processes involved in preparing assessment tasks require students to work independently, this study sought to investigate the technologies used within students' PLEs during assessment preparation, completion and submission processes. The research reported in this paper particularly focused on two groups of undergraduate students in two higher education institutions in Australia.

While much research has been conducted on the technologies students use during their leisure time and during their university studies in general (for example, Castaneda & Soto, 2010; Gosper et al., 2013; Gosper et al., 2014; Hight, Khoo, Cowie, & Torrens, 2014; Wang, Niiya, Mark, Reich, & Warschauer, 2015), less is known about the technologies used by higher education students during the specific processes of preparing, completing and submitting assessment tasks as required components of their university degrees.

Background

The definition of a PLE has evolved since the first notions emerged of students using technology to learn (Goldstein & Miller, 1976). Whilst there is not necessarily only one way to describe a PLE at present (Fiedler & Väljataga, 2010), researchers are beginning to develop various ways of defining this emerging concept. Attwell (2007b), for example, describes a PLE as being "comprised of all the different tools we use in our everyday life for learning" (p. 4). Dabbagh and Kitsantas (2012) describe a PLE as a "potentially promising pedagogical approach for both integrating formal and informal learning using social media and supporting student self-regulated learning in higher education contexts" (p. 3).

Due to the multiplicity of understandings about learning, it is important to acknowledge that social constructivist learning theory clearly describes the type of learning that takes place within a PLE (van Harmelen, 2008; Wild, Mdritscher, & Sigurdarson, 2008). One reason is that the learning environment offered by a PLE provides scaffolding for the learner which is an important component of this theory. The interactive aspect of working in the social media environment allows students a level of personalisation to their learning that frames their overall learning experience. The shared environment promotes levels of engagement and management, from content sharing, to collaborating, through to aggregation and finally to synthesis (Dabbagh & Kitsantas, 2012). Additionally, participating in a social network is at the heart of a PLE and social constructivism theory indicates that learning takes place within a community of practice (Vygotsky, 1933/1978).

There is some consensus around the emerging understanding of a PLE. One view is that a PLE encompasses the concept of a learner that is not restricted to the institutional community and formal learning networks but instead able to access a much broader community of practice (Dabbagh & Kitsantas, 2012; Fiedler & Väljataga, 2010; Wild et al., 2008). A PLE is underpinned by the idea of an independent learner who is actively involved in their own learning (van Harmelen, 2008). Whilst previously the LMS was at the centre of student learning experiences (Gosper et al., 2013), this research explored how multiple technologies may work together to form students' PLEs. A PLE, then, is clearly broader than the LMS and has the potential to cater for today's learner who needs flexibility to utilise all available components of their learning environment (Taraghi et al., 2009).

A PLE is defined as an approach to learning in which an individual uses tools of technology to acquire new knowledge and skills within dedicated and non-dedicated settings (Attwell, 2007b). The environment is personal in that each individual may use different tools to learn. The terms "dedicated" and "non-dedicated" are used in place of "formal" and "informal" to acknowledge that formal and informal learning can occur within dedicated settings, as well as non-dedicated settings (Smith, 1988). For example, when taking a course, a student can learn what the teacher is teaching, that is, the objectives or learning outcomes of the course. But within this dedicated setting, a student can also learn other information about the topic being taught which is not necessarily part of the formal

structure of the course. Conversely, even outside of a structured learning environment, there may be more formal learning happening, as when a person uses a language app to study a foreign language.

While many learners have traditionally used an LMS it is important to consider how the shift to a PLE occurs (Wild et al., 2008). Taraghi et al. (2009) defined crucial aspects for the shift from a LMS to a PLE as including: personalisation, content, social involvement, ownership, educational and organisational culture and technological aspects (p. 2). If these support networks are to be created it is vital that curriculum designers are aware that learners need digital literacy skills to establish a PLE; they also must be aware how learners interact with tools, artefacts and their social network (Wild et al., 2008).

The technologies that underpin the PLE typically comprise informal learning environments and networks that encompass unstructured learning, as defined earlier in the paper. Because the technologies used by college and university students are constantly changing, more contemporary research is required in this field. As technology has become more complex, the technology encompassed has increased from the simple computer program (Goldstein & Miller, 1976) to including new, flexible technologies. Examples of these technologies are tablets, smart phones, laptops and web services (van Harmelen, 2008). Integral to PLEs are Web 2.0 technologies denoting a new generation of web-based tools, environments, and services that enable new forms of collaboration and knowledge sharing between users (Margaryan, Littlejohn, & Vojt, 2011). Web 2.0 technologies are as much a concept as they are a technology. As a concept they characterise the ideas of openness, personalisation, customisation, collaboration, social networking, social presence and user-generated content. As a technology, they represent the second generation of technology available on the internet. The qualitative shift represented by this change allows anyone with an internet connection to access and edit a website, to be involved in a wiki or a blog, and to connect with other users. Such technology also provides opportunities to extend and enhance human communication capabilities. Dabbagh and Kitsantas (2012) suggest that social media can facilitate the creation of PLEs to help learners aggregate and share the results of learning achievements, participate in collective knowledge generation and manage their own meaning making. They also describe a pedagogical framework that lecturers can employ to demonstrate how social media can be used to create these PLEs while also promoting learner-centred pedagogy and facilitating self-regulated learning.

As well as the benefits of social media and Web 2.0 technologies, students' PLES will be shaped by their need to fulfill assessments task requirements in higher education. The focus in our study on students' use of their PLEs in assessment is important as assessment in higher education drives learning:

> For most students, assessment requirements literally define the curriculum. Assessment is a potent strategic tool for educators with which to spell out the learning that will be rewarded and to guide students into effective approaches to study. Equally, however, poorly designed assessment has the potential to hinder learning or stifle curriculum innovation (James, McInnis, & Devlin, 2002, p. 7).

Overall there has been a lack of theoretical perspectives of assessment in higher education (Yorke, 2003) and this trend appears to extend to considering the role of assessment in students' PLEs. Some research has been conducted into the PLEs used by school students (Clark, Logan, Luckin, Mee, & Oliver, 2009) and higher education students (Valjataga & Laanpere, 2010) but more work is required to determine the types of technologies used by college and university students when preparing their assessment tasks. Atwell (2007) proposes that the development of a PLE has the potential to actually broaden and change the nature of assessment.

The research study

This reported study focused on university students' use of specific technologies within their Personal Learning Environments (PLEs) by attempting to offer new insights into how to help students integrate their informal use of technologies with their institution's technologies. Specifically, the focus of the research was to determine the technologies and devices used by students for their assessment tasks including studying for tests and examinations, as well as preparing projects and assignments for evaluation as components of their degrees. The technologies these students use define their PLEs

within the context of their assessment tasks. Because there is still some doubt about how much guidance students need to use these technologies for learning, specifically in university learning contexts for assessment purposes, this project aimed to extend our knowledge of students' PLEs which would allow a framework to be developed. The framework will guide the purposeful use of technologies that are typically used as part of their informal PLEs. This framework will synthesise the findings from this first stage of the study and is currently under development for publication at a future date.

Research setting: Institutions, courses and students

Participants were recruited from two Australian Higher Education Institutions: Edith Cowan University and Avondale College of Higher Education. Edith Cowan University (ECU) is a multi-campus institution located in Perth, Western Australia. ECU is a young university and is an institution that promotes multiple entry pathways. The students who responded to the survey and participated in the focus groups and mapping exercises from ECU were drawn from two metropolitan campuses with about 100 students on each campus. They were second year students comprising a mixture of mature age students and school leavers, and they were predominantly female. All were studying to be generalist primary school teachers. These students chose to undertake the unit MAE2240: Foundations of Primary Mathematics Education in a face-to-face, on campus mode of delivery rather than in online/distance mode. Avondale College of Higher Education is located in Cooranbong, New South Wales, between Sydney and Newcastle. The students who responded to the survey and participated in the focus groups from Avondale were comprised of students enrolled in either a Bachelor of Arts/Bachelor of Teaching or a Bachelor of Arts degree, majoring in areas such as Ancient History, Visual Arts or Communications. More than half of these students were female and most were in the second or third year of their degree. The majority of these students were studying to be secondary teachers with a smaller group involved in the visual arts and writing strands of a Communications bachelor-level degree. All of the Avondale students who completed the survey were studying as on-campus students rather than in online or distance mode. For further details about the number of students enrolled in each of the institutions and in each of the units, see Table 1 below.

Table 1: Enrolment numbers in each institution and in each unit

Institution	Unit	Specialisation/ Profile	Number	%
ECU	MAE2240	Second Year B.Ed and B/Teach (Primary)	24	63
Avondale	CCCR15000	First Year BA COMMs students	4	11
Avondale	HIST21000	Most Yr 1, 2 B.A. B/Teach & B.A.	8	21
Avondale	ARTS34300	Third year Visual Arts students	2	5
		TOTAL	**38***	**100**

*One of 39 survey participants who did not indicate in which unit he or she was enrolled.

The following information describes the students who completed the survey.

- Of the 39 students who completed the survey, 24, or 62%, were from Edith Cowan University, while 15, or 38%, were from Avondale College of Higher Education.
- Of the 39 students who responded to the survey, all were enrolled as on-campus students.
- Most of the students were below 20 years of age or between 20 and 24 years of age.
- The majority of the students who contributed to the surveys, 27, or 69%, were second-year students.
- The majority of the students who contributed to the surveys, 31, or 78%, were female.

The following information describes the students who participated in the focus groups and mapping exercises.

- Of the 9 students who participated in the focus groups and mapping exercises, 5, or 56%, came from Edith Cowan University, while 4, or 44%, were from Avondale College of Higher Education.
- Of the 9 students who participated in the focus groups and mapping exercises, all were enrolled as on-campus students.
- Most of the students were below 20 years of age or between 20 and 24 years of age.
- The majority of the students who participated in the focus groups and mapping exercises, 9, or 78%, were second-year students.

- The majority of the students, 6, or 67%, were female.

Research methodology

A mixed methods approach was adopted to determine how students used varied types of technologies, involving both an online survey and focus groups which incorporating a mapping exercise. This mixed methods approach was based upon the work of Clark et al. (2009), with their permission, who followed a similar procedure. The purpose of the questionnaire was to reveal the technologies most commonly used by students for assessment purposes that formed their PLEs. The data from the focus groups, including a mapping exercises, were intended to supplement the survey results and to determine specifically how students use various technologies for assessment purposes within their PLEs. As well as answering questions during the focus groups, the students completed a mapping activity in which they drew their PLEs.

Data collection
In the online survey, after being asked some demographic information, students were requested to identify the five most common types of technologies or online sites they used to prepare their college or university assessment tasks. Students were asked to list the technologies or online sites they used, as well as the other technologies or online sites which they did not use, but which they thought could be useful. In addition, they were asked about technologies or online sites that detracted or distracted them from their studies and from completing their assessment tasks. For the remainder of the survey, students were presented with names of websites, methods of communicating online, searching sites or search engines, online resources, online gaming sites, and digital devices, and were asked to rate how frequently they used them to prepare their assessment tasks. The surveys were administered to students from Avondale College of Higher Education and Edith Cowan University.

During the focus group sessions, students were asked about how they used technologies for assessment purposes. Specifically, they were asked about the technologies and devices they personally used, the technologies and devices they saw being used by others, the mobile nature of technologies and devices, and they also predicted uses of technologies and devices. Students were also asked to draw a representation of their PLE. These drawings included labels and phrases to describe the technologies, drawings of technologies, annotations and visual representations of how the technologies relate to one another or are clustered (see Figure 1 later in the paper).

Data analysis
The survey data were analysed by calculating frequencies and descriptive statistics. An analysis was done of the demographic data to determine the participants' backgrounds. This analysis included calculating the number of participants, the number of students from each institution, the degrees students were enrolled in, the year of course/degree they were enrolled in, the unit/subject they were enrolled in, the enrolment mode, the number of students of each age, and the number of males and females.

To determine the most common technologies or sites used for assessment tasks, the responses to the open-ended questions were classified into one of eight categories: 1) Library, journal databases and academic resources; 2) Devices (laptop, computer in library, smartphone, etc.); 3) Software (Word, PowerPoint, etc.); 4) Learning Management System (for example, Moodle, Blackboard); 5) Content-specific websites (curriculum, professional, etc.); 6) Reference resources (encyclopedias, dictionaries, thesauruses, etc.); 7) Social media and popular online sites (Facebook, YouTube, etc.); and 8) Apps. Frequencies were obtained for each category and the specific responses under each of these categories were grouped. Furthermore, frequencies were determined for each question, and conclusions were drawn regarding whether there were any other technologies or sites that the students did not use but thought could be useful when preparing their assessment tasks, as well as the technologies or sites that detracted or distracted them from working on their assessment tasks. The overall responses for these questions were then summarised. For the ratings of the specific resources, frequencies were tabulated and means were calculated under each category. The individual resources were then rank ordered within the categories to determine which were used most frequently.

Transcripts were made of the focus group discussions. The transcripts were reviewed to determine trends in the current and future use of technologies and devices by the students, as well as their

perceptions of the use of technologies and devices by their peers. One of the foci of the discussion was mobile technology. The transcripts were analysed using NVivo, obtaining frequencies of technologies or devices mentioned. Categories of each of the technologies or devices were then determined which enabled the identification of themes and common phrases. The students' drawings of their PLEs, constructed as a mapping exercise during the focus group discussions, were analysed to determine the technologies and devices used by students for assessment, as well as the connections between the technologies and their uses. Specifically, the analysis identified and summarised the spatial layout of nodes and the relations between them in order to identify and evaluate 1) the main technologies used; 2) connections between the technologies; 3) clusters or types of technologies; and 4) any technologies that appeared to be missing.

The results of the data analysis of the survey data were compared with the results of the data analysis from the focus groups and mapping exercises to establish credibility and trustworthiness of findings. This triangulation of the data established links between the two sets of data and allowed for a clearer picture of how students are using technology to complete their assessment tasks.

Findings

In the first component of the survey students were asked to list the five most common types of technologies or online sites they used in conjunction with their assessment tasks such as completing assignments and preparing for tests or assignments. The students provided 53 different responses and these ranged from highly specific information sites such as *ACARA: The Australian Curriculum, Assessment and Reporting Authority*, a website which deals with curriculum and assessment issues in Australian education, to pop culture sites like *YouTube*. The entries were classified according to the type of resources. Table 2, following, shows the frequencies of the resources listed by the students, broken down by category. The most popular resources used in relation to assessment preparation were academic digital sources such as library and journal databases, though this was closely followed by the physical devices used by students to access the internet – encompassing everything from laptops to smartphones. Other categories regularly mentioned included online reference resources, software and social media sites. Mentioned only occasionally were Learning Management Systems, content specific websites and downloadable applications.

Table 2: Technologies or online sites used to prepare assessment tasks

Library, journal databases and academic resources	36
Devices (e.g., laptop, computer in library, smartphone)	23
Software (e.g., Word, PPT)	18
Learning Management System (e.g., Moodle, Blackboard)	9
Content-specific websites (e.g., curriculum)	8
Reference resources (e.g., encyclopedia, dictionary, thesaurus)	27
Social media and popular online sites (e.g., Facebook, YouTube)	14
Apps	2
TOTAL TECHNOLOGIES/ SITES MENTIONED	137

Each of these categories were then explored with more detailed questions and the responses were broken down into more specific categories, with similar responses being grouped together. Table 3 shows the list of responses and their frequencies, as provided by the students in each area. In the largest category of library, journal databases and academic resources there was a wide variety of sites mentioned, many of which were mentioned only once. Those used more often were *Google Scholar*, journal databases such as *JSTOR*, *Primosearch* and books available online (e-books). Interestingly only one student mentioned readings prescribed by the lecturer.

Table 3: Library, journal databases and academic resources

College Library (online)	1	Library Sources/Searches	1
e-Books/Books	5	LibraryOne	2

Library Searches	2
Ecu Student Portal	1
Google Books	1
Google Scholar	7
Journal Articles/Internet Journals/Journals/ Online Databases for journal articles/JSTOR	6
Library databases	1

Prescribed Readings from the Lecturers	1
PrimoSearch	5
Proquest	1
Referencing Guides	1
University of England's online library	1
TOTAL ACADEMIC RESOURCES	36

The second most frequently reported resources used in the preparation of assessment tasks were categorised as *Reference Resources* and, probably unsurprisingly, *Google* was listed as the most frequently used resource. Others on the list had only minor numbers but included *Endnote*, the internet as a whole, online dictionaries and *Citefast*. When the category of *Devices* was broken down into detail it became clear that of the 23 responses, more than half (13) were using laptops for their assessments. Only four students claimed to be using tablets or convertible tablet/laptops and even less were using phones (3), desktop computers (2) or hardware calculators (1). In terms of *Software* mentioned in the survey, there were only 18 responses and 8 of these mentioned *Microsoft Word* as their software of choice. Other *Microsoft Office* programs such as *Excel* and *PowerPoint* were mention 6 times, while all other software had negligible mentions: *Adobe PDF Reader* (1), *OneNote* (1) and *Pages* (1). Of the 18 cited software products, 14 were *Microsoft* products.

Social Media and popular online sites was the fifth most frequently reported resource category used by students when they prepare for, and write their assessments. Of the 14 students who mentioned these social media sites, 10 of them cited *YouTube*. Other sites mentioned were *CiteMe*, *Facebook*, *One Drive* and *Sparknotes*. It would seem that in general students are not using traditional social media sites as part of their assessment tasks and are using only a few popular online sites. Less frequently reported were *Learning Management Systems*, with only nine students mentioning these and only two mentioned by name – *Moodle* (4) and *Blackboard* (5). These numbers seem unusually low given that many students are expected to find assessment information and submit assessments via these sites.

After the more general introductory questions, students were presented via the online survey with specific resources and asked to indicate how frequently they used them to prepare assessment tasks. These included websites, online communication, search programs, online media, online gaming, and digital devices. Table 4 shows the most commonly ranked responses mean responses. *Facebook* was the highest ranked website, followed by *YouTube*, *Instagram*, *Pinterest* and *Dropbox*. Students were given the option to list other websites. The unique responses to this question included *Pandora*, banking sites, *iTunes* and the App store, *Quizlet*, *Tumblr*, *Behance*, *Kidstube* and *Kids Britannica Encyclopaedia*. These last two were likely influenced by the fact that many of the students were preservice teachers. Students declared their most commonly used methods of online communication to be email, Messenger, online chat and discussion forums – in that order, though others mentioned included *Facebook*, texting, *iMessage*, *Blackboard*, *TES* (an online forum for educators) and *Scoodle*.

Table 4: Frequency of use for specific resources

#	Question	Never	Rarely	Occasionally	Frequently	Very frequently	Total responses	Mean
6	Facebook	3	1	4	4	18	30	4.10
18	YouTube	0	3	12	8	7	30	3.63
9	Instagram	16	2	1	2	10	31	2.61
13	Pinterest	10	6	5	7	3	31	2.58
4	Dropbox	12	10	4	3	2	31	2.13

When students were asked about the ways in which they search online for information to prepare for an assessment task, their responses (30 in total), revealed they use search engines far more

frequently than library databases. They were asked on a scale of 'never, rarely, occasionally, frequently and very frequently', how often they used these searching technologies and *Google* was by far the most frequently used with a mean score of 4.8, while library databases scored 3.67 and *Wikipedia*, 2.57. Other sites mentioned less than three times each included *Google Scholar*, *Chrome*, *Safari*, *Bing*, online libraries, *Google Books* and *YouTube*. Most students claimed that online gaming sites were not used when preparing assessments. The only item that rated highly enough to be worthy of mention was 'Casual games such as Candy Crush, Farmville, Angry Birds, PVZ etc'. The students were not clear on how these helped them prepare for the assessments other than to help them relax during study periods, an issue also mentioned during the focus groups.

When it came to the devices students used to prepare for an assessment task, the internet was most often mentioned. However, the devices being used to access the internet varied. Interestingly, the more portable devices (laptops and phones) were the most popular by far (4.84), with a mean a full point above the next most popular device – the desktop computer (3.27 mean). One student explained this in more detail:

> Regarding the use of desktop computers, most students I know only resort to these if a laptop is unavailable. Personally, I prefer to use my mobile phone and laptop for study/assessments. I rely heavily on my laptop to complete assignments and prefer online resources to hard cover ones as it is easier to use.

During the focus group discussions, students were encouraged to explain and expand on the ideas they offered in the surveys. The first question that students were asked in the focus groups was simply, "What are the most common types of technology or devices that you use, or that you see other students using?" The overwhelming response to this was that students use their laptops with tablets and phones as a secondary source of information. One student mentioned the use of the interactive whiteboard and a couple of students from both groups mentioned taking photos in class of presentations or notes. When describing the advantages of having technology available in class, one student suggested that, "What's good with that is they can have up the slides at the same time and then you can double click to go to your notes at the same time so you can be looking at the modified lecture slides at the same time as taking notes on them."

Both student groups were in agreement that the most commonly used technologies in class were tablets, phones and laptops – for example, accessing the *Blackboard* app to see lecture notes, looking at the module requirements and collecting information for later study. At home – most students were using their laptops in the final preparation of their assessments. Some students were storing online books on their laptops and others were accessing the digital books through their University iLibrary. One student described a *Facebook* group they regularly used for their study called *Perth WA Teachers*, which signposts textbooks for sale, shares program and lesson plans and allows people to ask each other about educational issues. Others used online groups to co-ordinate assignments and one student stated that "almost for every single one of my group or partner assignments, we've made a page or a group chat for it". Education students were using *Facebook* pages to communicate whilst on teaching practicums to keep up-to-date with how their other classmates were faring in the classroom. Students also discussed using *GoogleDrive* to pass documents back and forth that they were editing and working on as a group, particularly for larger files that might not fit applications like *Facebook*. The file-sharing sites, *GoogleDocs* and *Dropbox*, were also mentioned by both focus groups.

When it came to their word processing software most students used *Microsoft Word*, but they mentioned the fact that a lot of students used free software instead – *Open Office*, *Publisher* and *Pages* were mentioned. *OneNote* was also described as "really wonderful software," though the students laughingly admitted they still usually chose to use *Word*. Some students suggested they did not like to experiment with new software when they were busy with assessments – they stuck with things they knew and understood. Students were asked why they were using certain technologies over and above others and ease-of-use was the defining factor of choice. Words and phrases such as "familiarity", "short-learning curve" and "convenience" were used and students claimed to be more likely to try new technologies if they were recommended and explained by their peers rather than lecturers, tutors or librarians.

Another point discussed during the focus groups was the actual differences that using technologies

and the internet made to the ways students completed their assessment tasks. Most of them had never been without these technologies so the discussion was not comparative to a time when an assessment task was completed without using such technologies. Students found that laptops and online software and resources meant that they were portable and could work anywhere, but were limited by the availability of the internet (and in particular free access to the internet). A student described this flexibility as 'multi-tasking': "You can be at home doing the washing and reading a book the same time online." Another described his dependence on the internet in absolute terms: "I never do any assessments unless I've got the internet. When we had the floods, our internet access was cut for a week and I moved to my grandma's because she had internet access so I could do all my assignments. I just can't do them … I think because all my sources tend to be online." The biggest problems students faced with technologies were associated with the availability of power sources and free internet access. On the rural campus at Avondale, students also struggled with phone reception which they reported using to co-ordinate meetings with other students and, if Wi-Fi was not available, to tether their computers and phones together. A student from ECU mentioned that ergonomically students are always under physical pressure from carrying tablets and laptops. However, despite any obstacle to their use, students were united in their belief that possessing or having access to a tablet or laptop was essential to being a modern student – going so far as to suggest that they should be provided by the University and paid back via HECS debt.

Overall, the students who participated in this study across two institutions demonstrated a strong preference for technologies and devices that were portable. Their concerns with the use of technologies for assessment purposes were largely focused on internet connectivity, phone coverage and the availability of Wi-Fi.

Discussion and recommendations

The students who participated in this study reported *Google Scholar* as one of the most used technologies for completing assessment tasks. However, they appeared to use very few technologies that were recommended by their lecturers (such as library databases or the institution's LMS); a similar finding was noted by Gosper et al. (2014) who reported an interest in "the number of popular technologies that students use at their own volition" (p. 299). In the study reported in this paper, the most commonly used physical devices, perhaps predictably, were portable devices such as laptops, tablets and smartphones. Students tended to view these physical technologies as central to their PLEs which was evident in their PLE drawings, as shown in Figure 1. Less emphasis was placed on the use of social media than other studies have reported (Mbati, 2013; Wang et al., 2015) but students did appreciate technologies that allowed them to share resources, ideas and support during assessment preparation processes. They especially appreciated the informality and interactivity offered by *Facebook* but did not show any preference or consistent demand for traditional desktop technologies such as printers or desktop computers, a trend also evident in the *2015 NMC Technology Outlook for Australian Tertiary Education: A Horizon Project Regional Report* (The New Media Consortium, 2015).

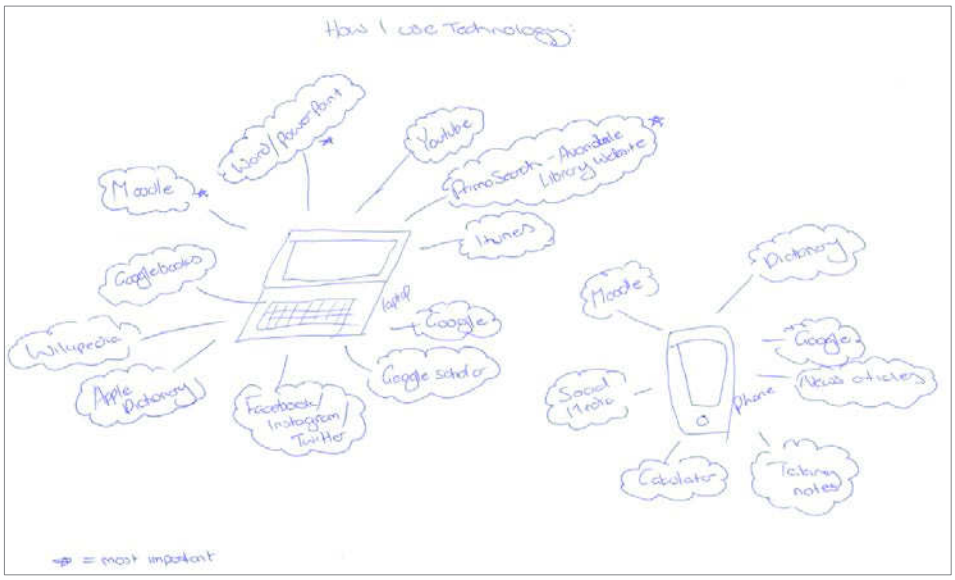


Figure 1: Sample of technology mapping exercise

Based on the findings of this project, students' use of technologies when preparing assessment tasks could be considered far less formal, as noted by Attwell (2007b), than the prescribed use of the institution's LMS or library resources. The variety of technologies used by the students in this study was not wide, a finding which echoes the work of Margaryan, Littlejohn and Vojt (2011): "students use a limited range of mainly established technologies" (p. 429). Even so, this finding conflicts somewhat with the outcomes of Gosper et al.'s research (2014) which found "wider access to freely available open resources and new technologies such as Smartphones and iPads" (p. 290). Because the completion of assessment tasks may be viewed as a high stakes activity by students and lecturers alike, the narrower than expected range and the less than adventurous use of technologies evident in this project may have been due to students' concerns about straying too far from the assessment task specifications. Furthermore, the typical approach of completing assessment tasks just before their due date may have also been a reason that students tended to choose less innovative technologies that required a "higher learning curve" when completing assessment tasks.

Despite the narrow range noted in some aspects of the students' technology use, the locations in which the technologies were used by the students in this project incorporated a range of both formal and informal contexts which may have been attributed to the increased use of mobile technologies, also a factor in the changing use of technology reported by other researchers (Gosper et al., 2014; The New Media Consortium, 2015). Even so, the affordances of mobile technologies were reported by the students in this project mainly in terms of their flexibility and portability rather than their capacity to enable social networking with others, which has been reported elsewhere (Cochrane & Withell, 2013). Perhaps the flexibility and convenience of technologies were emphasised above and beyond their social capacities because some aspects of assessment tasks typically require students to be less social, requiring more independent activity, than the generalised use of technologies for study and learning. The increased trend for flexible and mobile use of technologies for learning purposes aligns closely with the "bring your own device" approach and the increasing role of mobile apps, recently reported in reports such as the *2015 NMC Technology Outlook for Australian Tertiary Education* (The New Media Consortium, 2015, p. 4).

Learning management systems (LMSs) provide faculty members and students access to a wide range of learning applications and services (Conde, García, Rodríguez-Conde, Alier, & García-Holgado, 2014). In their first phase of a qualitative research study, Hustad and Arntzen (2013) reported that participants appreciated the benefit of having all the information in one place, which allowed students to access information anytime and anyplace, while allowing faculty to communicate with students very easily. Hustad and Arntzen (2013) also reported challenges which faculty and students had with the LMS. Participants expressed concerns with organisation and structure, as well as ease-of-use and ease of sharing knowledge. Further, they expressed concerns about the limited time that the information on the LMS was available. The limited available of the information is not conducive for life-long learning. Participants also talked about the challenge of sharing information

from one course to another. In LMSs, each class is typically independent from one another; as Hustad and Arntzen (2013) expressed it, each is its “information silo". This further inhibits the development of personal learning, where the insights from different classes may not be easily integrated to create personal learning environments (PLEs).

The central role of the LMS in an institutional context may be at odds with students' views about the LMS, as indicated to an extent by Taraghi, Ebner, Till and Mühlburger's (2009) work: "Nowadays a shift from an institution-centred approach to a learner-centred one becomes necessary to allow individuality through the learning process and to think about learning strategies in general" (p. 1:10). This finding also aligns with the increasing role of adaptive learning technologies that "refer to software and online platforms that adjust to individual students’ needs as they learn" (The New Media Consortium, 2015, p. 17). Personal learning technologies allow for “instruction to be personalized to users’ actions and interests, to provide assistance when needed and present instruction that is understandable, engaging, and situated in relevant and meaningful contexts (Walkington, 2013, p. 932). Because of perceived inflexibility of some LMSs, there is very little room for personalization. If, on the other hand, more control were to be given to students to integrate their own personal learning systems into the LMS, this may would result in a more personalised learning management system.

As a solution to the limitations of the learning management system, Stantchev, Colomo-Palacios, Soto-Acosta, and Misra (2014) advocate the integration of cloud-based applications into the LMS. While this may solve some problems, it does not address the limitations of access to information. Conde et al. (2014) therefore, advocate that the LMS be made open to allow for the seamless integration of information from the LMS to a student’s PLE. In a study of such an arrangement, Conde et al. found that this seamless integration personalized the learning environment and positively contributed to students' learning.

Hustad and Arntzen (2013) reported a limited use of some of the more interactive technologies, such as discussion board. Although the findings from our study did not indicate a strong use of the LMS in either institution included in the study, Gosper et al. (2014) recent report, *Student use of technologies for learning: What has changed since 2010?*, reported an increased use in some LMS functions. These variations in the findings across studies about the popularity or oversight of the LMS may simply be accountable to the varied ways in which the LMS is used at each institution.

A number of recommendations emerged from this study and they are presented here for consideration by other higher education institutions with students similar to those described throughout this paper. This research indicates that students tend to be more independent, device-wise, compared to previous eras which may have seen students depend on class sets of laptops or tablets. Such resource sets no longer appear necessary. Also, when institutions maintain tight control over institutional devices, this may prevent innovative use of technology by lecturers and students, particularly in the preparation for, and completion of, assessments. Instead, it may be more worthwhile for the institution to contribute infrastructure towards Wi-Fi technology which extends affordances such as device portability, mobility and flexibility.

Just as Dabbagh and Kitsantas (2012) acknowledged the potential role of PLEs to support the development of students' self-regulated learning practices, the recognition and promotion of students' use of varied technologies in association with assessment tasks may facilitate student independence. However, there is some tension between the extent to which students are willing to innovate using technology and the extent they are willing to take risks in the assessment arena, although they did show some tendency towards initiating, contributing to and accessing technologies which facilitated sharing of ideas and resources. Modelling the use of innovative technology by lecturers may also serve to encourage students to extend their use of technologies. Furthermore, incorporating students' use of technologies is an important curriculum design consideration (Könings et al., 2005) but the current use of the LMS may require some modification to meet contemporary students' expectations in terms of the its capacity to offer responsive and personalised learning experiences. While the findings of this study suggest that students, on the whole, did not perceive the LMS being used in a way that was clearly relevant to their learning or their assessment needs, there were opportunities to use the LMS as a launching pad from which to link to other available technologies such as relevant search engines, collaborative social media software and innovative apps.

Conclusion

In contrast with other studies on PLEs, this study focused on technologies used by undergraduate students for assessment-related tasks. Two cohorts from different institutions were surveyed and participated in focus groups during which they also drew representations of their PLEs. When accessing academic resources, these students used a variety of websites, especially *Google Scholar*, journal databases and e-books, but the LMS used at each institution did not dominate their thinking. The most commonly used physical devices were portable, including laptops, tablets and smartphones, which students tended to view as central to their PLEs. Students placed high importance on being connected to the internet, especially via Wi-Fi technology, and having phone coverage. However, their use of social media in association with assessment use, although valued as a sharing mechanism, was not as widespread as has been reported in other studies about the use of technology in general by higher education students. Definite preferences were shown for software and tools which were easy to use, convenient to access and quick to learn, especially when recommended by their peers. Although the students' use of technology was considered narrower than expected, they did not feel restricted by their institution's formal technological networks, suggesting their PLEs were broader that the collection of technologies offered by an LMS.

More research is required to investigate the contexts in which these main technologies are used by students in association with assessment and the connections between these technologies. Methods used by university students to collate technologies within a single, unifying technology cluster may also be investigated and discovered. From this study, there is some indication that social technologies may be used less during assessment tasks than for general learning purposes. Investigation into how technologies are used by postgraduate students for assessment tasks is also warranted. These areas of research are planned for the following stages of the study.

References

Attwell, G. (2007a). E-portfolio: The DNA of the Personal Learning Environment? *Journal of e-Learning and Knowledge Society, 3*(2). Retrieved from http://www.pontydysgu.org/wp-content/uploads/2008/02/eportolioDNAofPLEjournal.pdf

Attwell, G. (2007b). The personal learning environments: The future of eLearning? *eLearning Papers, 2*(1), 1-8.

Castaneda, L., & Soto, J. (2010). Building personal learning environments by using and mixing ICT tools in a professional way. *Digital Education Review, 18*, 9-25.

Clark, W., Logan, K., Luckin, R., Mee, A., & Oliver, M. (2009). Beyond Web 2.0: Mapping the technology landscapes of young learners. *Journal of Computer Assisted Learning, 25*(1), 56-69.

Cochrane, T., & Withell, A. (2013). Do 21st Century students dream of electric sheep? A mobile social media framework for creative pedagogies. In H. Carter, M. Gosper & J. Hedberg (Eds.), *Electric Dreams. Proceedings ascilite 2013 Sydney* (pp. 151-161). Macquarie University: Australasian Society for Computers in Learning in Tertiary Education (ASCILITE).

Conde, M. A., García, F., Rodríguez-Conde, M. J., Alier, M., & García-Holgado, A. (2014). Perceived openness of Learning Management Systems by students and teachers in education and technology courses. *Computers in Human Behavior, 31*(517-526).

Conradie, P. W. (2014). Supporting self-directed learning by connectivism and Personal Learning Environments. *International Journal of Information and Education Technology, 4*(3), 254-259.

Cross, J. (2006). The low-hanging fruit Is tasty. *Internet Time Blog*. Retrieved from http://www.internettime.com/2006/04/informal-learning-clo-april-06/

Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and Higher Education, 15*(1), 3-8.

Drexler, W. (2010). The networked student model for construction of personal learning environments: Balancing teacher control and student autonomy. *Australasian Journal of Educational Technology, 36*(3), 369-385.

Fiedler, S., & Väljataga, T. (2010). Interventions for second-order change in higher education: Challenges and barriers. *Electronic Journal of e-Learning, 8*(2), 85 - 92.

Goldstein, I. P., & Miller, M. L. (1976). AI Based Personal Learning Environments: Directions for long term research. Retrieved 06 May, 2015, from http://files.eric.ed.gov/fulltext/ED207580.pdf

Gosper, M., Malfroy, J., & McKenzie, J. (2013). Students' experiences and expectations of technologies: An Australian study designed to inform planning and development decisions. *Australasian Journal of Educational Technology, 29*(2), 268-282.
Gosper, M., McKenzie, J., Pizzica, J., Malfroy, J., & Ashford-Rowe, K. (2014). Student use of technologies for learning: What has changed since 2010? In B. Hegarty, J. McDonald & S. K. Loke (Eds.), *Rhetoric and Reality: Critical perspectives on educational technology. Proceedings ascilite Dunedin 2014* (pp. 290-301). Dunedin, New Zealand: Australasian Society for Computers in Learning in Tertiary Education.
Harvey, L. (2015). Analytic Quality Glossary, Quality Research International. Retrieved 14 October, 2015, from http://www.qualityresearchinternational.com/glossary/
Hight, C., Khoo, E., Cowie, B., & Torrens, R. (2014). Software literacies in the tertiary environment. In B. Hegarty, J. McDonald & S. K. Loke (Eds.), *Rhetoric and Reality: Critical perspectives on educational technology. Proceedings ASCILITE Dunedin 2014* (pp. 410-415). Dunedin, New Zealand: Australasian Society for Computers in Learning in Tertiary Education (ASCILITE).
Hustad, E., & Arntzen, A. A. (2013). Facilitating teaching and learning capabilities in social learning management systems: Challenges, issues, and implications for design. *Journal of Integrated Design & Process Science, 17*(1), 17-35.
James, R., McInnis, C., & Devlin, M. (2002). *Assessing learning in Australian universities : Ideas, strategies and resources for quality in student assessment*. Melbourne, Vic: Centre for the Study of Higher Education for the Australian Universities Teaching Committee.
Jenkins, M., Walker, R., & Voce, J. (2014). Achieving flexibility? The rhetoric and reality of the role of learning technologies in UK higher education. In B. Hegarty, J. McDonald & S. K. Loke (Eds.), *Rhetoric and Reality: Critical perspectives on educational technology. Proceedings ASCILITE Dunedin 2014* (pp. 545-548). Dunedin, New Zealand: Australasian Society for Computers in Learning in Tertiary Education (ASCILITE).
Johnson, M. W., & Sherlock, D. (2014). Beyond the Personal Learning Environment: Attachment and control in the classroom of the future. *Interactive Learning Environments. Special Issue: Learning management system: evolving from silos to structures, 22*(2), 146-164.
Könings, K. D., Brand-Gruwel, S., & van Merriënboer, J. J. J. G. (2005). Towards more powerful learning environments through combining the perspectives of designers, teachers, and students. *British Journal of Educational Psychology, 75*(4), 654-660.
Margaryan, A., Littlejohn, A., & Vojt, G. (2011). Are digital natives a myth or reality? University students' use of digital technologies. *Computers & Education, 56*(2), 429-440.
Mbati, L. (2013). Online social media applications for constructivism and observational learning. *International Review of Research in Open and Distance Learning, 14*(5). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1579/2709
Smith, M. (1988). *Developing youth work. Informal education, mutual aid and popular practice*. Milton Keynes: Open University Press.
Stantchev, V., Colomo-Palacios, R., Soto-Acosta, P., & Misra, S. (2014). Learning management systems and cloud file hosting services: A study on students' acceptance. *Computers in Human Behavior, 31*, 612-619.
Taraghi, B., Ebner, M., Till, G., & Mühlburger , H. (2009). *Personal Learning Environment: A conceptual study*. Paper presented at the ICL2009
The New Media Consortium. (2015). *2015 NMC Technology Outlook for Australian Tertiary Education: A Horizon Project Regional Report*. Austin, TX: The New Media Consortium.
Valjataga, T., & Laanpere, M. (2010). Learner control and personal learning environment: A challenge for instructional design. *Interactive Learning Environments, 18*(3), 277-291.
van Harmelen, M. (2008). Design trajectories: Four experiments in PLE implementation. *Interactive Learning Environments, 16*(1), 35-46.
Vygotsky, L. (1933/1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.
Walkington, C. A. (2013). Using adaptive learning technologies to personalize instruction to student interests: The impact of relevant contexts on performance and learning outcomes. *Journal of Educational Psychology, 105*(4), 932-945.
Wang, Y., Niiya, M., Mark, G., Reich, S., & Warschauer, M. (2015). Coming of age (digitally): An ecological view of social media use among college students *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (pp. 571-582). Vancouver, BC, Canada.
Wild, F., Mdritscher, F., & Sigurdarson, S. (2008). Designing for change: Mash-up personal learning environments. *eLearning Papers, 9*. Retrieved from http://oro.open.ac.uk/25253/1/media15972.pdf

Yorke, M. (2003). Formative assessment in higher education: Moves towards theory and the enhancement of pedogoic practice. *Higher Education, 45*(4), 477-501.

Lounsbury, L., Mildenhall, P., Bolton, D., Northcote, M., & Anderson, A. (2015). Higher education students' use of technologies for assessment within Personal Learning Environments (PLEs). In T. Reiners, B.R. von Konsky, D. Gibson, V. Chang, L. Irving, & K. Clarke (Eds.), *Globally connected, digitally enabled.* Proceedings ascilite 2015 in Perth (pp. 190-203).

Note: All published papers are refereed, having undergone a double-blind peer-review process.



The author(s) assign a Creative Commons by attribution licence enabling others to distribute, remix, tweak, and build upon their work, even commercially, as long as credit is given to the author(s) for the original creation.