Mobile Personal Learning Environments: An Exploration of Interactivity in a South African Architectural Technology Context

Abstract: This study investigates aspects of mobile personal learning environments (MPLEs) where on-the-move, higher education stakeholders – academics, lecturers and students are purported to use mobile devices and applications to learn informally. The study proposes considerations that support effectiveness of MPLEs in an Architectural Technology context. Pertinent literature and empirical data was sequentially analyzed and categorized as learning management systems; technological requirements; and socially-driven mobile education. Four emergent themes were noted – user experience; socially-driven mobile education; mobile productivity; and patterns of personalization. Future research opportunities include the exploration of personal social networking technologies; digital differences; and types of learning associated with MPLEs.

Introduction

This study presents an extract of findings from the primary researcher's doctoral research, conducted in an undergraduate Architectural Technology context in South Africa. The following research question is posed: *What considerations should be contemplated by higher education stakeholders regarding mobile personal learning environments?*

The Architectural Technology context of the study is defined in Fig. 1. The innovative blended learning modality comprised two on-campus, face-to-face block sessions per year and distance learning supported formally by institutionally-customised educational technologies. MPLEs contributed to the core of Fig.1 (item 4) and are viewed as PLEs that informally enhanced blended, technology-enhanced learning via personalised mobile mechanisms. Technology-enhanced learning may be mediated by social media and extended by mobile education, providing web-based opportunities for lecturers and students to share information (Harpur, 2017).

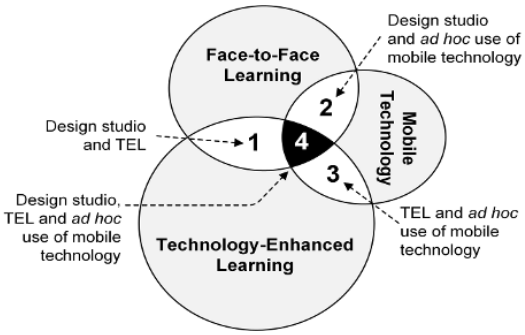

Fig. 1: Architectural Technology context

PLE projects address tool types and usage patterns, interactivity processes, and networked and lifelong learning environments (García-Peñalvo & Conde, 2015; Castañeda et al, 2016). They involve online communities, individuals and groups (Chan et al, 2006). Furthermore, researchers indicate that efforts to define the concept 'PLE' are tricky. PLEs represent customisable, user-centred learning environments. Castañeda et al. comment that a PLE embraces "opinions, people, resources and activities that are useful in the learning process" (García-Peñalvo & Conde, 2015:376). PLEs incorporate learning modalities, support lifelong learning and integrate emergent educational technologies. The emergence of PLEs originates from stakeholder frustration with performance of the institutional learning management system (Martindale & Dowdy, 2010). However, a student's PLE does not equate to or replace the institutional learning management system. Rather, it may be viewed as a constituent of a comprehensive learning toolset (Humanante-Ramos, García-Peñalvo & Conde-González, 2015). A PLE may be associated with seamless learning in everyday situations (Marin et al, 2016); may facilitate either face-to-face or distance learning (Chan et al, 2006); and may represent change processes that support learning and teaching (Attwell, 2007).

Research Method

The study is underpinned by a comprehensive literature study. Pertinent literature sources were imported into *ATLAS.ti V8* and analysed thematically, applying open and axial coding. Three key categories emerged from a review of literature sources, namely: learning management systems, technological requirements, and socially-driven mobile education.

The empirical portion of the study comprised an exploratory case study (Yin, 2014), defined by Fig. 1, supported the collection of data suited to the answering of the research question. It addressed opinions and attitudes of a small and specific sample of respondents, precluding the inclusion of in-depth statistical analysis. Thus, rather than proposing generalisation from the findings, the study aimed to achieve thematic resonance. Ethical clearance was obtained from the university where the research was conducted, prior to data collection.

A purposive, non-probabilistic sample of convenience (Oates, 2008) was selected from a population of educational stakeholders. Data collection methods included online surveys where custom-designed questionnaires were administered digitally among five Faculty Academics (A1–A5); 14 Architecture Students (S1–S14); and three Architecture Lecturers (L1–L3). A *Google Forms* instrument included ethical consent and demographic requirements together with open-ended, matrix-like and Likert-type response items associated with aspects of mobile interactivity. Questionnaire data was automatically download into *Excel* spreadsheets in readiness for analysis. Feedback from open-ended items was analysed thematically using *ATLAS.ti V8*. Analysis of matrix and Likert items led to basic descriptive statistics and indices illustrated via graphical visualisation. In addition, data collected during a semi-structured interview with the Faculty Head (FH) aimed to establish an institutional perspective. The interview comprised four questions addressing strategic issues. The interview was conducted *au distance* by smartphone. Conversation snippets were automatically recorded via a mobile application entitled *RecordMyCall* and then transcribed in readiness for qualitative data analysis using *ATLAS.ti V8*. Both open and axial coding techniques were applied, analysing outcomes from thick and rich data (Creswell, 2014). Empirical findings were categorised per the three emergent themes identified during analysis of literature sources (Friese, 2014). This qualitative study was evaluated by examining the trustworthiness of the study (1985), providing techniques that evaluated credibility, transferability, dependability and confirmability. Methods applied to enhance quality of the study, included: triangulation (Runeson & Höst, 2009), member-checking (Creswell, 2009), thick descriptions (Yin, 2014), and reflexivity (Noble & Smith, 2015) to support the enhancement of credibility, transferability, dependability and confirmability.

Theoretical Underpinnings

Pertinent literature is reviewed in this section and reported in three sections: learning management systems, technological requirements, and socially-driven mobile education.

Learning management systems

Institutional learning management systems facilitate interactivity between stakeholders providing conduits for delivery of educational content whilst supporting collaboration and communication activities. Learning management systems such as *Blackboard* and *Moodle* are used in combination with other systems (García-Peñalvo & Conde, 2015) and serve as tools for on-campus and at-home use (Wild, Lefrere & Scott, 2013; Ng, 2015). Learning management systems may present issues. Students expect certain tools e.g. Web 2.0 to offer a wide selection of options (Wild, Lefrere & Scott, 2013), unavailable when the portal is out of action (Bennett et al, 2012). The management of differing passwords may cause confusion (Khaddage et al, 2015). Compatibility of and access to *Blackboard* may be problematic via mobile devices (Mayisela, 2013). Perceived effectiveness is dependent on quality of interconnectivity between lecturers and students (Casanova, Moreira & Costa, 2011). Seamlessness is a sought-after yet challenging prerequisite (Khaddage et al, 2015). Learning management systems should be seamlessly integrated, improving interactivity and the quality of teaching and learning (Marin et al, 2016). They function as platforms – virtual learning environments which support the delivery of course content for technology-enhanced learning (Mcgill, Klobas & Renzi, 2014) and are used especially for distance education. Personal learning environments must support the quest of students to pursue their own personal learning avenues (Wild, Lefrere & Scott, 2013). Institutional virtual learning environments must be suited to and compatible with mobile devices and applications (Kukulska-Hulme, 2012).

Technological requirements

Compatibility issues are social and contextual and include lecturers and their MPLE tools. There is a match between the lecturer, digital tools, the tasks at hand, and the interface (Schoonenboom, 2014). Compatibility is a contextual challenge where lecturers and students work in differing spaces and time suited to their situations (Alrasheedi & Capretz, 2015). Ongoing maintenance with centralised updates is required to ensure compatibility with social and technical contexts (Tedre, Apiola & Cronjé, 2011). The importance of digital connections between students and their peers and lecturers is emphasized (Wang, Han & Yang, 2015). Use is made of WiFi connectivity, whether face-to-face in classrooms or remotely and online with other communities of students. Internet access facilitates many educational possibilities and is defined by specific requirements. Stakeholders require ubiquitous access to the Internet facilitating a mix of formal and informal learning (Lai, Khaddage & Knezek, 2013). Students must be able to easily access the Internet via the institutional learning management system. Consequently, institutions need to install wireless 'hotspots' wherever students are e.g. the library and their residences (Mayisela, 2013). Internet access offers lecturers and students many possibilities, including: the streamlining of support for infrastructure, ensuring continuous functioning of all digital systems (Mileva, Simpson & Thompson, 2008); the supply via the institutional virtual learning environments of Internet access for mobile technology (Kukulska-Hulme, 2012); and Incorporation of digital access to instant messaging, websites, games, music, downloads for educational research in and beyond classrooms (Lai, Khaddage & Knezek, 2013).

Socially-driven mobile education

Social technologies may serve as a means to digitally deliver additional course content via tablets (Harpur & De Villiers, 2015). This opportunity emphasises students' contributions to content where content may be gathered whilst bring on-the-move (Cochrane, Narayan & Oldfield, 2014). Collaborative benefits include the use of *Facebook* helped with the management of large classes (Rambe & Ng'ambi, 2014); provided a private communication space; and supported shy and 'silent' students. Social networking presents educational challenges (Rambe & Ng'ambi, 2014), including: trial-and-error approaches rather than bone fide options worthy of integration; academic rather than inter-student undertakings; limited technology-rich backgrounds; and confusion between social and academic contexts. Social networking technologies are change agents (Cochrane, Narayan & Oldfield, 2014) supporting greater levels of user-generated content – lecturers, students and lifelong learning (Kukulska-Hulme, 2012). Mobile devices and applications show potential to change educational design, influenced by time and space factors. Anywhere, any time learning is a feasibility (Lai, Khaddage & Knezek, 2013; Lytras et al, 2014). Hierarchical boundaries are reduced when students find they may consult lecturers formally yet on their own terms (Rambe & Ng'ambi, 2014). An implication of integrated educational mobile technology includes the evaluation of acquired versus achieved skill sets, suited to academic environments (Holotescu & Grosseck, 2012). Finally, Kitsantas et al. (2016) comment that while social networking technologies have a positive effect on learning, communication, and motivation, they also present negatives e.g. feelings of isolation.

Analysis and Discussion of Empirical Data

This section includes three areas of analysis and discussion, namely: Learning management systems, Technological requirements and Socially-driven mobile education.

Learning management systems

Participation and co-operation on projects encourages collaboration and communication between team-players, usually facilitated by a learning portal.

Collaboration

In this study, digital platforms such as *Facebook* and *WhatsApp* enabled by mobile devices were the main vehicles for collaboration (A5). Architecture Students were asked what they had noticed about the way students collaborated via personal mobile devices and applications to work on projects with each other. Responses included: *'some [mobile devices and applications] seem to work very well and others not' (S5); '... [collaboration] ... happens on a very tiny scale'* (S10); and *'not much ... [collaboration]... has been noticed'* (S14). These observations are supported by an Architecture Lecturer who commented: *'they don't collaborate as much as they should'* (L2). This perceived lack of collaboration did not seem to stem from apathy as students seemed *'... very comfortable and eager to learn if not familiar with the devices and applications'* (L3).

Communication

Exchange of information via Web 2.0 applications supports communication. Faculty Academics experienced student-communication in numerous ways, as: student-need for instant communication (A1); and lecturer-preferences for emailed contact keeping their mobile phone numbers private and complaining about receipt of *WhatsApp* or SMS communication at inappropriate times (A3). For Architecture Students, effective communication served several purposes. Networking with fellow students ensured *'getting information and alerts from … lectures as soon as something [arose] …'* (S1). Communication meant being able to *'… discuss topics and share ideas on … 'Hangout' page'* (S7); participate in *'discussions related to studying'* via closed *Facebook* and *WhatsApp* groups (S8). Communication occurred in differing ways (S12). *Facebook* communication was easy, allowing for continuing conversations (S8) while the sending and receiving of short messages via *WhatsApp* worked well due to immediacy of responses (S14). Mobile technologies facilitated the effective and efficient communication of notifications (L3) *'set on the SharePoint site to alert students of new posts'* (L1). However, one of the Architecture Lecturers expressed concern that the use of mobile technologies for communication purposes resulted in *'no eye contact'* (L2).

Learning portal

The learning portal mediates bi-directional educational dialogue. Whilst all Architecture Lecturers reported using laptops to access the portal, Architecture Students preferred the simultaneous use of diverse mobile device types – laptops, smartphones, netbooks and tablets. These observations suggest issues arising from learning portal access via any form of device type are worthy of attention. Regarding *Blackboard*, the institutional learning management system, a Faculty Academic advised that *'students avoid accessing it'* (A4). For students, the learning management system could take lessons from *Facebook* which benchmarked a satisfying environment and provided features well-suited to the improved receipt of notifications (S8). Finally, students suggested the conversion of the portal to an app enabling on-the-move access to webinars via mobile devices (S9, S13).

Technological requirements

Educational contexts emphasise technological requirements for compatibility, connectivity and effective Internet access for all associated stakeholders.

Compatibility

Compatibility of working teams via a network of diverse technologies depends on support for and integration of technologies. Mobile access should facilitate *'as many mobile operating systems and devices as possible'* (S11) and incorporate the integration of platforms using *'cloud services'* (L2).

Connectivity

Connectivity enables seamless interactivity for users. Connectivity is a big problem when students do not have sufficient data and are unable to connect to the campus WiFi (A1, A3). However successful connectivity offers Architecture Students the chance to *'connect and listen to other students crits and comments whilst working'* (S1); create hotspots, connecting laptops to mobile devices (S2), use mobile phone to link via WiFi for crits, webinars and work (S7, S8, S9). According to the understanding of Architecture Lecturers, students *'use laptops, some use tablets, none use cellphones'* (L2) and *'are extremely comfortable using mobile devices and applications'* (L3). Connectivity issues include bandwidth limitations (L2) and erratic network connectivity (L3).

Internet access

Web-based sites provide Internet access to educational resources. A Faculty Academic expressed a concern, commenting: *'the web has become a distraction and is not always used for the purpose it was created, namely a resource rather than the main source to gather information'* (A5). For Architecture Students, the Internet facilitates the uploading of work (S9) and access to online crits and sessions (S9, S10). While students suggested the inclusion of uncapped and reliable links to the Internet (S4, S9) while a lecturer called for Internet-enabled webinar sessions (L1).

Socially-driven mobile education

Social media platforms are driving ways mobile devices are used to enhance teaching and learning, calling for adaptation and flexibility of digital platforms, the incorporation of social networking, and the accommodation of Web 2.0 tools.

Digital platforms

Digital platforms offer data channels via mobile-enabled applications. Faculty Academics suggested digital platforms should not be limited within the institutional framework (A5), but rather be based on *'open source platforms that students can access easily'* (A4). A lack of integration concerned an Architecture Student who commented: *'... so many times during my crit session I wish I had ... [a] ... great sketching pad that ... [could] ... be integrated with the platform that we're using'* (S6).

Social networking

An Architecture Lecturer also expressed the need for both compatibility and integration attributes of digital platforms (L2). Social networking incorporates social media, social technologies and networking tools. For Faculty Academics, social networking is synonymous with *'communication services like WhatsApp'* (A1, A3), Both *Instagram* and *Facebook* are social communication sources in use by students who *'share info easily'* (A4, A5). Architecture Students reported using social networking technologies for various purposes. They reported networking with fellow students (S1); visiting educational pages on *Facebook*, using *Pinterest*, *Google+* and *Twitter* and streaming videos on *YouTube* (S4, S6, S7, S14). They uploaded their online work and participated in crit sessions with both architects and other students (S7). The *WhatsApp* group was used to discuss many architecture topics (S8, S9); to share ideas and to get information and updates (S10). Social networking technologies enabled communication with lecturers (S12); scaffolded research opportunities; and allowed the study of architecture website pages and the work prominent architects (S13).

Web 2.0 tools

Web 2.0 tools enhance user-interoperability, distinct from social networking. One Faculty Academic indicated the use of *iPad* technology during face-to-face student-interactivity to *'further illustrate or refer to examples during discussion'* (L3). *TED-Ed* sessions (S3) and webinars (S5, S13) were deemed by students to be satisfactory aspects of the *OpenArchitecture* programme. Feedback from the Faculty Head encapsulates the positive influence of Web 2.0 tools, contributing to the success of the Architectural Technology programme. He commented: students talk to each other even before class, amazing what *Facebook* does in creating a hype and so the vibe on campus when these students arrive is almost electric (FH). The sharing of information, helpful links for studying purposes and design ideas between students and their lecturers becomes feasible via MPLEs.

Reflections, Limitations and Delimiters, and Future Research

The research question, posed at the start of the study, is revisited: *What considerations should be contemplated by higher education stakeholders regarding mobile personal learning environments?*

Reflections

The study reviewed theoretically-based and empirically-determined elements that provide considerations that support educational stakeholders regarding the MPLE domain. Reflection on these findings led to four themes, namely: user experience; socially-driven mobile education; mobile productivity; and patterns of personalisation.

User experience is subjective and hedonic

Findings of the study resonate with the view of Kukulska (2012) that mature students have specific hopes for positive experiences of technology. User experience (UX) is associated subjective and hedonic interactivity. In accordance with ISO 9241-2010 (2010), UX represents " … a person's perceptions and responses that result from the use and/or anticipated use of a product, system or service". Good UX contributes to perception of quality and hence satisfaction. Stakeholders deem their MPLEs to be successful if they are satisfied with interactive experiences and if their expectations are met. In this study, stakeholders offer examples of both good and poor UX. Enthusiastic students with positive attitude perceive the informal and educational potential of their MPLEs.

Respondents enjoyed easy digital communication via a closed *Facebook* group which enabled the informal sharing of course-related ideas, experienced as a pleasurable reality. The challenges of connectivity and Internet access associated with institutional learning portals are well-documented (Stickel & Hum, 2008; García-Peñalvo & Conde, 2015). Respondents reported *Blackboard* lacked integration capabilities and was not suited to all mobile device types. Interactive experiences with *Blackboard* established a perception of inferior quality. Consequently, respondents indicated they avoided its use using other MPLE mechanisms to achieve interactivity. From a student perspective, *Blackboard* could take lessons from *Facebook*.

Thus MPLEs, seen as the informal combination of mobile technology and PLEs, may offer solutions to requirements for lifelong learning (García-Peñalvo & Conde, 2015). In agreement with Mileva et al. (2008) students should be included as stakeholders.

Mobile education is socially-driven

MPLEs provide easy and fast access to social networks and concomitant social communication patterns enabling collaboration (Fischer, Smolnik & Galletta, 2013; Khaddage, Müller & Flintoff, 2016) and communication (Stickel & Hum, 2008; Kitsantas et al, 2016). Rather than being socially-supported, learning is becoming socially-driven due to the affordances of mobile ICT. This observation emphasises the need for seamless integration of social networking technologies such as *Facebook*, *Twitter* and *LinkedIn* into institutional learning management systems and portals (Humanante-Ramos, García-Peñalvo & Conde-González, 2015; Marin et al, 2016), enabling interconnectivity and interpersonal contact.

Respondents suggested the sharing of design concepts between students and their lecturers became a social feasibility. *Facebook* provided a platform, an information sharing space where ideas and guides to course-related topics were posted.

Mobile productivity increases educational effectiveness

Students may learn beyond the classroom via their MPLEs where the learning process extends to encompass the world-of-work. The study supports findings of other researchers and indicates that MPLEs have the potential to facilitate lifelong-learning productivity (García-Peñalvo & Conde, 2015) via Web 2.0 tools (Stickel & Hum, 2008; Oldfield & Herrington, 2012; Gikas & Grant, 2013; Kitsantas et al, 2016) and digital platforms (Stickel & Hum, 2008).

In alignment with Park (2014:29), lecturers suggest mobile devices provide "pedagogical affordances", communicating a more formal perspective. On-the-move convenience and productivity are viewed as technological, rather than practical suggesting MPLEs offer opportunities for informal research via personal devices and applications.

Patterns of personalisation characterise interactivity

Higher education academics, students and lecturers report personal preferences and patterns of usage that characterise their MPLEs. Differences in digital behaviour include choices of social networking technologies used for educational purposes (Holotescu & Grosseck, 2012; Oldfield & Herrington, 2012; Mayisela, 2013; Webb, 2014; Kitsantas et al, 2016). An MPLE may comprise a collection of idiosyncratic and customisable technologies used for communication and collaboration activities such as chat, forum, and wiki applications (Prieto, Migueláñez & García-Peñalvo, 2013). Interactive technologies offer improved self-control and self-regulation of their learning experiences. However, the study highlighted too that in the Architectural Technology domain, not all stakeholders share the hype of the mobile-in-education movement where a measure of formal eye-to-eye interactivity is supplanted by the affordances of MPLEs.

Limitations and delimiters

The study was limited in several ways. Methodological limitations included the size of the respondent group and scope of the study – a single higher education domain and context. Additionally, the researcher was unable to interface directly with the respondents. The subjective nature of the qualitative study suggested the possibility of researcher bias. The cross-sectional design precluded exploration of changing MPLE patterns and trends over time. The *ad hoc* use mobile technology for educational interactivity is a dynamically evolving topic implying that literature sources are outdated as soon as a paper has been drafted.

The study did not undertake in-depth investigation of digital differences and divides, even though these topics emerged from case study data. Furthermore, a study of the effective integration of MPLEs into institutional infrastructures was excluded, as was the hands-on observation of interactivity via social technologies. No effort was made to determine the types of learning that had occurred.

Future research

The study highlighted several opportunities for future research. Further research could be based on a larger sample determined by differing MPLE contexts. Multiple cases could be included for differing faculties;

fulltime as well as part-time students; and data collection by interviews and focus groups. Longitudinal studies could explore evolutionary MPLE trends. A systematic literature review would strengthen and update theoretical underpinnings. Other research environments could include both public and private higher education contexts where differences could provide interesting contributions to the body of knowledge. Whereas the study highlighted incidences of digital differences occurring across the four themes delineated in this section, a deeper review of digital differences aimed at bridging identified divides invites further research. A design-based research project which encompassed interactive and integrated interventions could inform educational theory, policies and practices. Finally, digital observation of the educational potential of social technologies and the types of learning resulting from MPLE interactivity, are still under-researched topics.

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