
MAKING IT MOBILE: CHANGING APPROACHES TO CLINICAL LEARNING ENVIRONMENTS

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Introduction

Mobile technologies are increasingly being adopted: institutionally by medical schools and independently by students in order to support learning in the clinical environment [1, 2, 3]. Whilst the ubiquitous nature of mobile technologies brings us one step closer to a vision of learning anytime, anywhere [4], the theoretical basis of mobile learning (m-learning) is poorly understood, inadequately researched and as a result, often poorly supported [5, 6]. This research was a direct result of these concerns.

Critical review of relevant literature

Although too exhaustive to include in this application, an expansive review was done based on the following framework (Figure 1).

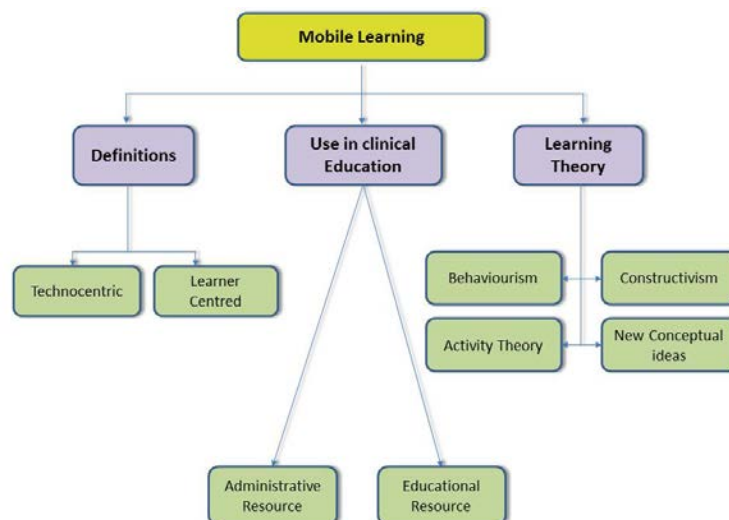


Figure 1. Structure of the literature review

Defining mobile learning

M-learning lacks a universal definition and it is instead often described in terms of its reported characteristics. To others it is a branch of e-learning, (the educational use of technology), distinct only by the mobile nature of the technologies that afford its practice [6, 7, 8, 9]. Whilst this may well ease its diffusion into academia it will inevitably weaken its

contribution and diminish its coherence [10]. My view is that it is a process of learning supported by the use of mobile technologies; where learning is a personal construct defined by the individual, and mobile technologies are; wireless, electronic devices that are easily mobile. This includes mobile phones, smartphones, handheld MP3 players, portable e-book readers, PDAs and tablet PCs but excludes laptops and any other typically wired or stationary device.

Using mobile technologies in clinical education

Mobile technologies have been utilised in various ways to support learning in medical education. Medical schools in the United States paved the way with mobile technologies preloaded with essential university texts [11] and the provision of static electronic learning resources via mobile technologies is now widespread [12, 13, 14, 15, 16]. Additionally they have been used to support assessments [17] and reflective practice [18, 19]. Whilst students generally report high levels of satisfaction with m-learning experiences [16], common barriers to its' utility are a poor user interface [3, 15], and the lack of guidance regarding mobile etiquette or, 'mobiquette' [3].

Theoretical basis of m-learning

Current learning theory supporting m-learning is sparse and in order to progress as an academic field it is imperative to understand and develop its' theoretical basis [20, 20, 22]. Due to the breadth of m-learning activities possible it is unrealistic to attempt to apply a single, fixed theory to it and it is more important to develop a number of ways to view and conceptualise the process. Elements of behaviourism, constructivism, and activity theory have been applied to m-learning and new conceptual models are being presented.³

Simplistically, behaviourism is applicable within m-learning when the use of the mobile devices invokes a stimulus response such as through text commands [23]. Constructivism is emerging as the predominant learning theory [22, 23, 24] and it is proposed that mobile technologies provide means of social connectedness and facilitate sharing of experiences, thus meaning is socially constructed by the participants of mobile technology facilitated conversations. These conversations can be between people, through the medium of a mobile technology; or via interaction with the mobile technology itself i.e. web browsing.

Expanding upon constructivism, the literature invited a detailed review of activity theory and its application within m-learning [3, 25, 26]. Historically activity theory has been used in the study of human-computer interaction and posits that learning emerges from conscious activity as a result of our interactions with others and the environment, mediated by tools within the activity system. Commentators therefore suggest m-learning can be thought of as a dialectical relationship between two dominant spaces whereby; learning is conceptually carried out in a semiotic space and physically in the technological space under the influence of the external environment [26].

Theoretical framework

Phenomenon and the theoretical perspective

The phenomenon sought in this exploratory study is: medical students' experiences of using mobile technologies in the context of medical education. In keeping with realist ontology [27] participants views are viewed as external, objective and tangible [28]. However, I acknowledge my approach as a researcher is shaped by the context of the theory I possess and this inevitably influences what I observe. Therefore the reality uncovered is only known probabilistically hence the study was carried out from a post positivist stance [29]. In light of this attempts were made to maintain objectivity and limit bias in order to maintain methodological rigour [30].

Methodology

This research looks to explore a complex human experience thus I have opted to follow a broad qualitative approach that can be compared to a cross-sectional survey methodology [28].

Methods

Sample

The sampling strategy is a hybrid between convenience and purposive. An email was sent to all third year medical students asking those who felt they had experience of m-learning to come forward, thus an attempt was made to attain a group with knowledge of the phenomenon to enable fuller description. Those responding first were allocated an interview. Six third year medical students at Newcastle University took part; two females and four males. The selection of third year medical students was informed by themes from within the literature which suggested they would have a greater experience of m-learning. These are geographical mobility [22], self-directed learners [16], and a greater frequency of ad-hoc learning due to improbability of clinical placements [3]. It was also a pragmatic in terms of their availability.

Data collection

Individual interviews were used owing to their flexibility, ability to gather extensive detail about a phenomenon and capacity to engage difficult and open ended questions [31]. I discredited methods such as focus groups because of their tendency to generate a collective opinion rather than accounts of individual experiences [29]. Interviews were semi structured and topics were generated based upon existing literature, reflection upon personal m-learning experience and discussion with the head of faculty IT [32]. Careful consideration was given to the research questions throughout the process to ensure content was fitting. A pilot interview was undertaken to ensure questions were clear, unambiguous and unbiased.

I reflected on each interview prior to the next, and content was amended for subsequent interviews enabling a fuller description of the phenomenon. A rigid structure was unnecessary as I did not intend to compare individuals. Notes were taken as a fail-safe for any recording errors and to highlight key points to come back to or probe further. The interviews were audiotaped to facilitate analysis. This afforded my ability to revisit the data in its raw form and ensure my developing analysis was true to the data.

Data analysis

Data was transcribed verbatim onto Microsoft Word. It was then organised and explained following thematic coding analysis. Codes are single words or phrases that attempt to capture the meaning of a phrase or sentence. Due attention was paid to negative statements and similar codes were grouped together by common meaning into categories, which closely represented the data but enabled a reduction in its size. Categories were defined based upon their codes and collective meaning. By reviewing the categories alongside the raw data I identified themes which captured something important in relation to my research questions and transcended the data.

Ethics

Ethical approval was obtained from the University Ethics Committee. Due reassurance was given to students as per the confidentiality and anonymity of data.

Aims and research questions

Aim

To explore medical student experiences of using mobile technologies in the context of their medical education, in order to develop a conceptual understanding of m-learning and inform academic practice at the university.

Research Questions

1. How and why are medical students using mobile technologies?
2. What are the barriers and facilitators of their use?
3. How can the university facilitate the use of m-learning?

Presentation and interpretation of results

The results of thematic analysis are presented in Figure 2

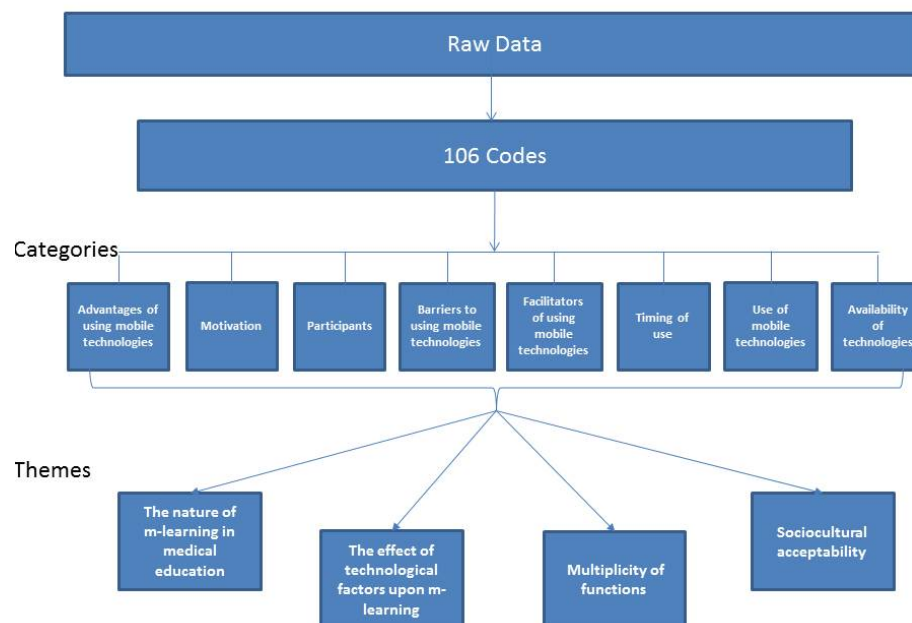


Figure 2. Results of Thematic Analysis

Exploration of themes

The nature of m-learning

The mainstay of m-learning was via smartphones due to convenience and as an adjunct learning aid, not a replacement. M-learning is typically spontaneous afforded by its speed and ability to utilise 'dead time'. It occurs in context with timely access to key facts and often involves an element of repetition.

it's right there when you have just seen it and it's in your memory, so at that time you can either remember it or read about it at the same time and I just feel you remember much more doing it that way. (F20)

Participants alluded that m-learning may encourage learning to become a process of knowing how to access information rather than actually understanding and brought up consideration for trustworthiness of resources. Trust is increased when references were provided or it was an electronic version of a known textbook.

I'd say maybe this is where the dangers come in, whether I know that I can access certain things so quickly like it's kind of a question of whether I need to devote this to my long term memory, or can I know that, oh I can just access that again just by typing it in. (E120)

I am sometimes wary that not all the information online is always reliable, whereas I would be quite happy to take for read something from well-known textbooks. (B213)

Multiplicity of functions

Participants choose to use mobile technologies due to their all in one nature. Primarily they would access information via the internet. Secondary to that is accessing embedded medical applications, PDFs and textbooks. The administrative function of mobile technologies is deemed an essential part of m-learning as it enhances productivity and communication with relevant people. However participants acknowledge the distractibility of these devices and acknowledge this influences their negative image hence a call to establish mobile etiquette.

You could be in a calendar, sending an email looking at a PDF reading an article, you know anything like that. (F32)

But I think there is still an etiquette needed because on the other side of the coin the phones still have cameras and other things. (F34)

The effect of technological factors upon m-learning

Participants have come to expect a stable internet connection thus in hospitals where connectivity is poor they feel unsupported and frustrated. Consequentially static applications enable them to overcome this but they are aware if something has been designed specifically for mobile technologies and this influences their persistence using that resource.

When there isn't a native mobile application it is clunky and disorganised. (D42)

Sociocultural Acceptability:

Participants expressed trepidation using phones in a clinical environment for a mixture of reasons including fear of it interfering with equipment or doctor-patient interactions and the unprofessional image they portray. They feel doctors' attitudes are able to facilitate this in either direction and there is an assumption that a generational gap impacts upon the social acceptability of devices. There is however, a perception of increased uptake of mobile technologies by doctors on the wards and positive interest being shown by staff.

Well you know phones in hospitals, it's something that people frown on really isn't it. (A34)

I feel better using it when doctors are encouraging of its use; most I have encountered have a fairly pro-technology attitude. (B176)

Discussion

Participants use their mobile devices sporadically as a supplementary learning resource in order to gather small chunks of information in a timely manner and one heavily based in the context of the clinical situation. They choose to do so due to the convenience and relative ease which is afforded by the portability and high functionality of the device giving them access to a breadth of information as and when required. Whilst this process is facilitated by their intuitive designs sociocultural factors also play a significant role and in reality there remains an overshadowing negative perception of mobile devices within the clinical environment. Thus for m-learning to become mainstream within medical education a shift of attitudes is required.

My results substantiate the stance held both within medical education literature and outside of it positing activity theory as a useful framework from which to view m-learning [3, 22, 25, 26]. Each element of the activity system is described by participants within this study: the mobile technology is viewed as the tool to mediate attaining outcomes, central importance is given to the social context of the activity and participants aptly describe how their use of mobile technologies is influenced by rules of conduct and their role within the community. Interestingly the findings demonstrate that rules are not explicit and participants develop self-imposed rules to guide their use. This creates tension within the activity system and often presents itself as a barrier to achieving outcomes.

The administrative functions of devices are regarded with great importance by the participants of this study, so much so it is factored into participants' descriptions of m-learning. They suggest the administrative function should be regarded synonymously with learning on the device as it improves their productivity, supports their organisation of learning and resources and enables them to converse with others by email which has brought about collaborative learning. This integration has led to a blurring of the lines between what may have been traditionally considered learning and what may have been considered administration and it now seems somewhat artificial to separate the two due to the high functionality of these all-in-one devices.

Considering my results alongside Engstroms [33] depiction of an activity system I have created conceptual model of m-learning in a clinical context (Figure 3). It is intended that this should be informative for curriculum development and the integration of m-learning strategies.

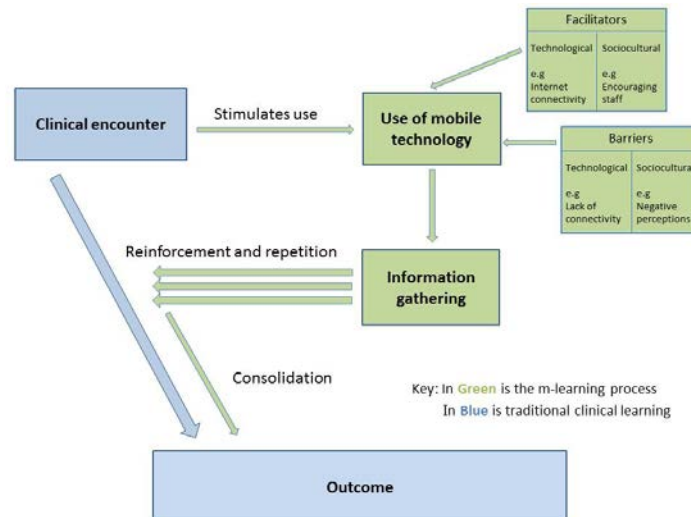


Figure 3. My conceptual model of the m-learning process

Study Strengths and Limitations

The sample was self-selecting; both interested and motivated to discuss the topic in question. Whilst this improves the validity of a qualitative study [34], it means that other valuable perspectives on the phenomenon may have been missed and my sample size makes it impossible to capture the phenomena completely. Despite barriers and facilitators not being part of my main aim, participants' responses identified that they were important and I concluded they would be the crux of informing practice and I therefore focused on this research question in depth. In reality identifying barriers and facilitators may have been better suited to a detailed exploration on their own.

Implications for practice

How can the University facilitate the use of mobile technologies?

Institutional support for m-learning encourages the use of mobile technologies [35, 36] and participants within this study describe a lack of support from their University and perceive this as a barrier to m-learning. Given the utility participants attribute to their use of mobile technologies in their studies I believe it is worthwhile developing support for its practice. As this is a very practical research question I have displayed the strategies to support m-learning in bullet form.

M-learning can be supported by:

- Developing and disseminating rules of mobile technology use – ‘mobiquote’.
- Addressing negative perceptions by:
 - making staff aware of the legitimacy of using mobile technologies as a learning device;
 - making staff aware of any m-learning strategies employed by the University;
 - consider providing an identifiable case for use in hospital so that the technology is branded as a learning tool.

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- Formatting existing, or designing new resources to be optimised for mobile technologies by considering that resources should be:
 - optimised first and foremost for smartphones;
 - quick, easy, and convenient to use;
 - present information in bite-sized chunks;
 - easily searchable;
 - up to date;
 - offline where possible;
 - aiming to avoid activities that require prolonged typing.
- Providing students with timetable access on their mobile technology.
- Providing internet access in the hospital.

Implications for future research

Simplistically there would be benefit from reviewing the impact of the suggested implications for practice. Additionally a deeper review of the applicability and contribution of various learning theories in order to inform the design and delivery of future m-learning resources and strategies would be advantageous to the field. Interesting research would arise from further exploration of the concept of Google assisted memory and the question: does knowing how to access information equate to knowing?

References

1. Leeds University (2011). *Faculty of Medicine and Health*. Retrieved 04/07/2012, 2012, from <https://www.medicine.leeds.ac.uk>
2. University of Manchester (2012). *Manchester Medical School*. Retrieved 04/07/2012, 2012, from <http://estore.manchester.ac.uk/browse/department.asp?compid=1&modid=1&deptid=53>
3. Davies, B. Et al. (2012). Mobile Medical Education (MoMed) – how mobile information resources contribute to learning for undergraduate clinical students: a mixed methods study. In *BMC Medical Education*, 12(1), (p. 1).
4. Sharples, M.; Amedillo Sanchez, I.; Milrad, M. and Vavoula, G. (2009). Mobile learning: small devices, big issues. In N. Balacheff, S. Ludvigsen, T. de Jong & S. Barnes (eds.), *Technology Enhanced Learning: Principles and Products*, (pp. 233–249). Heidelberg, Germany: Springer.
5. Price, L. and Kirkwood, A. (2010). Technology enhanced learning – where’s the evidence? In C.H. Steel, M.J. Keppell, P. Gerbic & S. Housego (eds.), *Curriculum, technology & transformation for an unknown future. Proceedings ascilite Sydney 2010*, (pp. 772-782). <http://www.ascilite.org.au/conferences/sydney10/procs/Price-concise.pdf>
6. Muyinda, P.B. (2007). MLearning: pedagogical, technical and organisational hypes and realities. In *Campus-Wide Information Systems*, 24(2), (pp. 97-104).

7. Ellaway, R. and Masters, K. (2008). AMEE Guide 32: E-Learning in medical education Part 1: Learning, teaching and assessment. In *Medical Teacher*, 30(5), (pp. 455-473).
8. Trifonova, A. (2003). *Mobille Learning – Review of Literature*. University of Trento, Department of Information and Communication Technology.
9. Vivanco, J., Demianyk, B. Et al. (2011). *Work in progress – A smartphone application as a teaching tool in undergraduate nursing education*.
10. Traxler, J. (2005). *Defining Mobile Learning*. IADIS International Conference Mobile Learning 2005.
11. Dolan, B. (2011). Nine medical schools that support mobile learning. In *mobihealthnews blog*, August 12, 2011. Retrieved 08/07/2012, from <http://mobihealthnews.com/12346/nine-medical-schools-that-support-mobile-learning>
12. Belshaw, D. (2011). *University of Leeds Mobile Learning*. Retrieved 07/07/2012, 2012, from <https://mobilelearninginfokit.pbworks.com/w/page/44701349/University%20of%20Leeds%20Medical%20School>
13. Smørdal, O. and Gregory, J. (2003). Personal Digital Assistants in medical education and practice. In *Journal of Computer Assisted Learning*, 19(3), (pp. 320-329).
14. Ferenchick, G.; Fetters, M. et al. (2008). Just in time: Technology to disseminate curriculum and manage educational requirements with mobile technology. In *Teaching and Learning in Medicine*, 20(1), (pp. 44-52).
15. Garrett, B.M. and Jackson, C. (2006). A mobile clinical e-portfolio for nursing and medical students, using wireless personal digital assistants (PDAs). In *Nurse Educ Today*, 26(8), (pp. 647-654).
16. Coulby, C.; Hennessey, S. et al. (2011). The use of mobile technology for work-based assessment: The student experience. In *British Journal of Educational Technology*, 42(2), (pp. 251-265).
17. Torre, D.M.; Simpson, D.E. et al. (2007). Feasibility, reliability and user satisfaction with a PDA-based mini-CEX to evaluate the clinical skills of third-year medical students. In *Teach Learn Med*, 19(3), (pp. 271-277).
18. Kneebone, H. and Brenton, R (2005). Training perioperative specialist practitioners. In A. Kukulska Hulme & J. Traxler (eds.), *Mobile learning: a handbook for educators and trainers*, (pp. 106-115) London: Routledge.
19. Scott, S.K.; Burn, D.; Koulias, M.; Campbell, D. and Phelps, M. (2012). “Wherever, whenever” learning in Medicine: Interactive mobile case-based project. Ascilite 2010 Sydney The University of Sydney.
20. Goh, T. and Kinshuk, D. (2006). *Getting Ready for mobile learning- adaptation perspective*. In *Journal of Educational Multimedia and Hypermedia*, 15(2), (pp. 175-198).

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21. Conole, C. (2004). E-learning the hype and the reality. In *Journal of Interactive Media in Education*, 2004(12).
22. Sharples, M. (2005). Towards a Theory of Mobile Learning. In *Proceedings of MLearn 2005 conference*.
23. Ruan, G.; Wang, J. et al. (2009). *Theoretical foundations of mobile learning mediated by technology*.
24. Song, J. (2008). *Mobile Learning: What is Going on?* 2008 International Symposium on Knowledge Acquisition and Modeling Queensland University.
25. Vavoula, G.N. and McAndrew, P. (2005). *Pedagogical Methodologies and Paradigms – A study of Mobile Learning Practices*. Retrieved 09/07/2012, 2012, from http://www.mobilearn.org/download/results/public_deliverables/MOBIlearn_D4.4_Final.pdf
26. Taylor, J.; Sharples, M.; O'Malley, C.; Vavoula, G. and Waycot, J. (2005). Towards a Task Model of Mobile Learning a Dialectical Approach'. In P. McAndrew & A. Jones (eds.), *International Journal of Learning Technology Special Issue: Interactions Objects and outcomes in Learning*.
27. Crotty, M. (2009). *The foundations of social research: meaning and perspective in the research process*. London: Sage Publications.
28. Cohen, L.; Manion, L. Et al. (2007). *Research methods in education*. London; New York, Routledge.
29. Robson, C. (2011). *Real world research: a resource for users of social research methods in applied settings*. Chichester, W.
30. Bligh, J. and Prideaux, D. (2002). Research in medical education: Asking the right questions. In *Medical Education*, 36(12), (pp. 1114-1115).
31. Oppenheim, A.N. (1992). *Questionnaire Design, interviewing and Attitude Measurement*. London Pinter Available at <http://books.google.co.uk/books?id=6V4GnZS7TO4C&printsec=frontcover#v=onepage&q&f=false>. Accessed 31/07/2012
32. Moss, J. (2012). *M-learning at Newcastle University Medical School*. Personal Communication D. Puntis.
33. Engeström, Y. (1987). *Learning by Expanding: an activity-theoretical approach to developmental research*. Helsinki, Orienta-Konsultit
34. Barbour, R.S. (2001). Checklists for improving rigour in qualitative research: a case of the tail wagging the dog? In *BMJ*, 322(7294), (pp. 1115-1117).
35. Chatterley, T. and Chojecki, D. (2010). Personal digital assistant usage among undergraduate medical students: exploring trends, barriers, and the advent of smartphones. In *J Med Libr Assoc*, 98(2), (pp. 157-160).

36. Grasso, M.A.; Yen, M.J. and Mintz, M.L. (2006). Survey of handheld computing among medical students. In *Comput Methods Programs Biomed*, 82(3), (pp. 196-202).