DOES MOBILE TECHNOLOGY HELP ACHIEVE LEARNING OUTCOMES?

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Introduction

Mobile technology seems promising as an effective learning tool as it can be highly personalised and at the same time offer collaborative learning opportunities. Mobile technology is closely associated with self-directed learning, characterised by personal ownership of knowledge, personal ideas generated within learners' learning context and where learning is controlled by the learner (Laurillard, 2009). Lai, Khaddage, and Knezek (2013) found that learners associate smart gadgets with information acquisition sharing and seeking. They contend that mobile access and information behaviour are components that facilitate the shift between formal and informal learning in the digital age.

Many schools have started to allow or even encourage their students to use smart gadgets for learning purpose. For examples, SIM University (UniSIM) in Singapore has rolled out Interactive Study Guide (ISG) for students to access course materials from their tablets or smart phones. Students in Norway used digital tools, engaging on a personal level and drawing on experiences outside the school to collaborate and produce an online newspaper for their school (Erstad, Gilje, Sefton-Green, and Vasbø, 2009). In less developed countries, such as Nepal, medical students used mobile phones to access Facebook and websites to engage in discussion related to their formal learning (Pimmer, Linxen, & Gröhbiel, 2012).

Despite positive findings that suggest that mobile technology has facilitated learning, it is nevertheless unclear whether the smart gadgets can effectively help achieve desired learning outcomes, although they offer easy access to infinite amounts of information, thereby availing new forms of sociality, play, creativity, social activism, networking and collaboration (Weigel, James & Gardner, 2009).

This paper examines the various phases of development of digital media and the implications on learning. It subsequently discussed the research questions, data collection methods and findings. The last part is an analysis of implications in view of our findings.

This paper, which is part of the researcher's study on informal learning, aims to address this research concern to find out if the mobile technology has helped achieve the desired learning outcomes.

Progressing from Web 1.0, Web 2.0 to Web 3.0

Following Giannini (2010), new media is taken to mean any "electronically delivered media", which may include social media and mobile media. Beyond Social media, "although considered to be synonymous with social networks like Facebook and Twitter, there are non-network types where participants can produce, publish, control, critique, rank and interact with online content" (Tracey L Tuten, Advertising 2.0 (Wesport, CT: Praeger, 2008, 20). This includes blogs and micro-blogs, video sharing, bookmarking applications, wikis, forums, and opinion sites, as well as social networking sites. It is the power of interaction that often encourages informal learning in casual and non-working contexts.

On usage of the phrase "digital media", Drotner et al. (2008) has this to say: "Digital media is a catch phrase for an ensemble of technologies. Some are 'born' digital, such as the personal computer, the internet, games consoles and mobile devices; others can be made digital, such as print media, radio and television, because of the technical possibilities to digitize all signs so that text, image, sound and numbers can be brought on to the same technological platform and begin to 'speak together' in multifaceted ways."

We shall find it hard to dispute the impact of how technology and in particular digital media has made in the way we live, work and socialize with each other. There are many evidences that many are engaged in technology-based informal learning beyond the class rooms (Cranmer 2006, Impact2 2003, Facer et al. 2003). Sefton-Green (2005, p.3) concluded that, "Information and Communication Technologies (ICT) allow children and young people a wide variety of activities and experiences that can support learning,…(that) do not take place in traditional educational settings. In fact many of these may not be considered `educational' according to our conventional understanding of that term."

The terms "Web 1.0" and "Web 2.0", though referring to different periods in the evolution of the World Wide Web, were defined simultaneously, wherein the idea behind Web 2.0 was formulated by distinguishing it from its predecessor (O'Reilly, 2005).

Web 1.0 is used to reference the static Internet publishing platforms signature of personal and corporate websites (or "brochureware"), with minimal visible interactivity between reader and content creator (Evans, 2006). O'Reilly notes the transition from Web 1.0 wasn't the result of failure to sustain the World Wide Web as an industry, but that "(t)he bursting of the dot-com bubble in the fall of 2001 marked a turning point for the web" and "in fact bubbles and consequent shakeouts appear to be a common feature of all technological revolutions."

Web 2.0 is used to describe any form of service or software that focuses on social networking and community-building; in contrast to its predecessor, the Web 2.0 platform is host to dynamic, ever-changing content that is open to readers turning into content creators through active participation and networking (Anderson, 2008). Where Web 1.0 is largely deemed "read-only" in scope, Web 2.0 brings information technology to the level of "read-write-execute", and is often synonymous or used interchangeably with such terms as social media, social networking, interactive media, and new media. As far as sustainability goes, commercial value in Web 2.0 technology lies in "the social capital gained by the network itself" (Drogos, 2007).

Web 2.0 uses read-write web and is all about user-generated content, focused on communities where people are consuming as well as contributing information through blogs or social network sites (SNS) like Flickr, YouTube, FaceBook and et cetera. There have been a number of studies into how SNS such as FaceBook has been used to facilitate formal learning (Steinfield et al 2008, Lampe et al 2008, Ellison et al 2007) , how information are shared (Stutzman 2007, Lewis et al. 2008) **.**

ASTD's recent study, The Rise of Social Media (2011), learning functions have not folly adopted many of the tools, technologies and concepts associate with Web 2.0, we are entering into Web 3.0, the semantic web. Web 3.0 comprises three components, namely semantic web, mobile web and the immersive internet.

Semantic web refers to technology that enables software to understand the meaning of data and uses natural language searches. Mobile web allows users to move seamlessly from one device to another and from one location to another. Immersive internet makes virtual worlds, augmented reality and 3-D environment possible.

Reflecting on the lessons learnt from the fall of Web 1.0, the technology sector is bracing itself at the peak of the Web 2.0 revolution by analyzing current trends that may mark the emergence of a "Web 3.0", or the rise of "the Semantic Web" (Berners-Lee, Hendler, & Lassila, 2001), "a world in which software "agents" perform Web-based tasks we often struggle to complete on our own" (Metz, 2007). Definitions of Web 3.0 are hardly concrete, however; Metz lists out a number of other possibilities, including "the 3D Web" (with reference to Second Life), "the Media-Centric Web" (using media to find other media), and "the Pervasive Web", which most closely resembles the current developments in cloud computing and mobile technology.

Expertus Inc & Training Industry Inc (2009) found that 50% of surveyed working adults taking formal education thought informal learning using Web 2.0 tools was critically important to them: 50% of respondents (working adults taking formal training) said that informal learning technologies (such as Web 2.0 tools like blogs and social networking sites) were critically important and 39% reported it was somewhat important.

ASTD's study, The Rise of Social Media (2011) examines the ways in which Web 3.0 technologies affect and influence learning today and the impact they may have in the future found the following key findings:
• High-performing organisations are more likely to have learning functions that are open to emerging technology and to use that technology to solve business problems;
• The use of mobile devices for learning is correlated with market performance and highly correlated with effective learning;
• The use of virtual worlds, simulations, augmented reality and multiplayer gaming technologies for learning are expected to increase dramatically in the next few years;
• Budget constraints and lack of leadership buy-in is the biggest obstacles to adoption.

Implications on Learning

Where Web 1.0 pushed the work from content creator to reader, and Web 2.0 allowed the reader to push back, Web 3.0 focuses on making the machines used in the transaction the key component in driving the technology age forward. Beginning with the emergence of the netbook platform (itself considered a technological transition period *vis-a-vis* Web 1.0), mobile computing has now exploded in popularity with the introduction of the smartphone, mobile tablets such as the iPad, their various platforms (IOS, Android and the up-and-coming Windows 8) and the distribution of mobile applications that such platforms carry with them. The evolution of mobile technology embodies the ideology behind the Semantic Web - an overt simplification in the way we compute while we commute.

Wheeler (2009) predicts that Web 3.0 will "not only promote learning that is more richly collaborative, it will also enable learners to come closer to `anytime, anyplace' learning and will provide intelligent solutions to web searching, document management and organization of content". Ohler (2008a; 2008b) opined the three areas Web 3.0 will impact education: knowledge construction; personal learning network maintenance and personal education administration. Web 3.0 allows computers to understand the meaning of information rather than displaying information (Morris, 2011).

Devedzic (2006) opined that Web 3.0 adaptive (learned by the system) and adaptable (configured by the learner) filtering of information achieves personalization in how learners acquire knowledge, progress in learning and basing on their intellectual capacities. This personalization will present information that is relevant, appropriate and at the right time. Students will benefit from knowledge construction as the semantic web will present multimedia report of searches. A smart agent operating in such ontologies would search out relevant learning materials based on learners' needs (Stojanovic, Staab, & Studer, 2001). Such smart agents would be able to help archive and document learners' learning products to facilitate collaborative work (Anderson & Whitelock, 2004). Integrated data will help students to develop more `holistic perspective' in learning (Reynard 2010, paragraph 4).

There are, however, a number of emerging assertions, which suggest that digital technologies have many beneficial roles to play in enriching and diversifying adult informal learning journeys and adult informal learning will increasingly need to make the best use of such technologies in order to remain successful in the future (Hawkey, 2002; Friesen & Anderson, 2004; Shuklina, 2001).

The FutureLab report (2009) titled, "A review of the current landscape of adult informal learning using digital technologies" suggests that four in five adults use some kind of technology to help them learn informally and men were more likely to use technology to learn informally than women (Hague & Logan, 2009). It also found that adults spend between eight and a half hours and 15 hours per week learning informally (Tough, 2002; Futurelab, 2009).

While the home was the most frequently mentioned location for informal learning, other locations for informal learning included at a friend or family member's home, at the library, on holiday, at a community centre, at a cafe and at museums, art galleries and exhibitions (Hague & Logan, 2009). This wide variety of locations highlights the way in which the further development of mobile technologies may have the potential to support adult informal learning as well as the importance of ensuring access to technology for learning across a variety of locations, not just in the home.

Research Questions

The research aims to find out what mobile gadgets adult learners use for learning, how they use it and the relation between the use of mobile gadget and its effectiveness of learning.

In summary, the key research questions are:

1.   The relation between the use of digital media and adult informal learning behaviour.

Adult informal learning behaviour is deemed to be in areas of learners' awareness of learning platforms; motivation to process information; opportunity to process information and the ability to process information. This will be analyzed using Clough et al. (2008) Informal Mobile Learning Framework, an adaptation of Patten et al. (2006) Mobile learning functional framework.

2.   The relation between the use of mobile gadgets and its effectiveness of learning (formal learning).

The effectiveness of learning will be measured using Bloom's Learning Outcomes or the scale of effectiveness for learning.

Research Methods

A two-phase mixed methods design was used where qualitative data were collected in the first phase and quantitative data in the second (Punch 2009, p 297). The mixed-method considers multiple perspectives, collecting data on processes and experiences along with objective data (Teddlie & Tashakkori, 2008 as cited in esourceresearch.org). The qualitative research was an initial study to supplement data to enhance the overall understanding and the quantitative experiment research will follow after (Johnson et al, 2007 as cited in esourceresearch.org).

A qualitative study used the Delphi Technique (subsequently referred to as the Delphi) consisting of a series of questionnaires to collect data that "seek to gain reliable consensus of opinions of a group of experts" (Linstone & Turoff 1975 as cited in Powell, 2003, p 376). It uses multiple iterations to develop a consensus of opinion concerning a specific topic (Ludwig, 1994 as cited in Hsu & Sandford, 2007 p 2). The primary characteristic and advantage of the Delphi is subject anonymity which reduces dominant individuals which often is a concern when using group-based processes to collect and synthesize information (Dalkey 1972, as cited in Hsu & Sanford, 2007 p 2).

Controlled feedback in the Delphi technique reduces the effect of "noise" that could distort data when dealing with group or individual interests rather than focusing on problem solving. The controlled feedback consists of" a well organised summary of the prior iteration intentionally distributed to the subjects which allows each participant an opportunity to generate further insights and more thoroughly clarify the information developed by previous iterations" (Hsu & Sandford 2007, p 2).

There are two rounds of data collection. In the first round, the Delphi process begins with an open-ended questionnaire. This serves to solicit specific information about a content area from the Delphi subjects (Custer, Scarcella, & Stewart 1999, as cited in Hsu & Sandford 2007, p 2). After the subjects' responses are collected, the information will be converted into a well-structured questionnaire. This questionnaire will be used as a survey instrument for the second round of data collection.

In the second round, the Delphi participant receives a second questionnaire and is asked to review the items summarised by the investigators based on the information collected in the first round. Panelists may be required to rate or "rank-order the items to establish preliminary priorities among items. As a result of round two, areas of agreement and disagreements are identified" (Ludwig, 1994, p 54-55 as cited in Hsu & Sandford, 2007 p 3).

The size of the respondents vary, special care is taken to ensure that the pool of respondents should not be too small that the pool is not representative of the judgements of the target issue. Too many respondents may encounter low response rates (Hsu & Sandford, 2007, p 3).

Based on a Delphi findings from UniSIM student respondents who have used ISG, the researcher examines if the mobile learning has helped adult learners achieve the desired learning outcomes.

Summary of Findings

1.   Activities and Devices

o   With the instructors' promotion to use mobile gadgets for learning, number of respondents using all mobile devices (Smartphone/Blackberry/Tablets) has increased from Week 1 to Week 6.
o   All participants engage actively in email/personal communication and searching for information when they are on mobile gadgets from Week 1 to Week 6.
o   Between weeks 1 and 6, respondents spent about 1 hour daily on mobile devices for the various activities stated (in the order): information & research, work, scheduling and ask organisation, data storage, communication, accessing social networks, watching videos, banking and financial services, playing games, photography and online shopping.

2.   Relation between learners' time spent on mobile gadgets and using mobile gadgets for learning.

o   There is no clear correlation between the numbers of hours spent on their mobile devices and using mobile devices to obtain course-specific information.

3.   Relation between learners' motivation to access informal learning platform(s) on digital media and their involvement in informal learning behaviour

o   There is no clear positive or negative relationship can be attributed in Week 1 and Week 6 when comparing the extent to which respondents agree that they are motivated to access information about course materials through mobile devices and time spent on internet for study.

o   The number of respondents who subscribed to news and information-only resources through mobile devices/apps remained constant between Week 1 and Week 6.

o   The respondents' motivation to obtain information about course material/subject matter from their mobile devices/apps has not changed from Week 1 to Week 6.

4.   Relation between using mobile gadgets and learning outcomes achieved

o   Respondents feel that they have achieved the attributes of learning in the areas of Knowledge and Application using mobile devices and apps.

Implications and Conclusions

The respondents in general are aware of using mobile technology for study purpose and are motivated to use it to post questions to ask for help, reading articles by others, reading status, and browsing links. They use and increase the use of mobile devices from Week 1 to Week 6 for various activities, which include self-directed learning.

However, the time spent on mobile devices does not seem to contribute to their actual behavior in using mobile devices for learning purpose, despite that the fact the instructors have actively promoted the idea from week 1 to week 6. In addition, the instructors' promotion of the idea of using mobile technology for learning for the past 6 weeks do not seem to have any effect on their motivation.

One of the key findings of this study is mobile learning seems to help achieve the lower-level learning outcomes, instead of the higher-level learning outcomes, such as Analysis, Synthesis and Evaluation.

Respondents feel the learning attributes they have achieved using mobile devices and applications are Knowledge and Application. These are the lower-level learning outcomes.

While the study yield some interesting findings, it has its limitation. It is very much based on the respondents' responses instead of an actual observation of how they achieve the learning outcomes. This can be theoretically achieved by matching with the actual examination scores. But this has become unlikely after Personal Data Protection policy is in place in Singapore.

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