M-LEARNING: IMPLICATIONS IN LEARNING DOMAIN SPECIFICITIES, ADAPTIVE LEARNING, FEEDBACK, AUGMENTED REALITY, AND THE FUTURE OF ONLINE LEARNING

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ABSTRACT

The aim of this paper is to examine the potential and effectiveness of M-learning in the field of Education and Learning domains. The purpose of this research is to illustrate how mobile technology can and is affecting novel change in instruction, from M-learning and the link to adaptive learning, to the uninitiated learner and capacities of m-learning. Followed by a model using direct examples from contemporary literature, looking at m-learning and feedback, m-learning tools, augmented reality and what are the ultimate implications for m-learning's long term uses, and where the future of mobile technology and education is heading, M-learning is becoming a fundamental form of technology that can enhance and contribute to adaptive learning. The results of this study show that m-learning is transforming the way of learners' access and disseminate learning content through mobility, ease of access and ability to provide instantaneous feedback, and the tacit link to other innovative forms of technology such as mobile applications and augmented reality tools.

Keywords: Mobile Learning, Augmented Reality, Feedback Modalities, Aurasma.

INTRODUCTION

How Do 20th Century Educators Facilitate Learning for 21st Century Learners?

The focus of this paper is to help shed light on the rapidly developing and innovative technological tool that many students, and educators use everyday. This tool is mobile technology and how mobile technology is revolutionizing learning environments. While many may think of mobile technology as being merely a cellular phone or "smart phone", the path that m-learning is taking will soon, if not already, rapidly outpace many of its already antiquated technological constraints. This paper posits that mobile learning should be redefined not as a technological device, but rather as a stand-alone idea called 'anywhere anytime learning'.

Throughout history, the rapid dissemination of knowledge has led to revolutions in learning and education. History has shown that, while the tools may act as a catalyst, it is rather the rapid and fluid dissemination of ideas and knowledge through the tool or medium within broad reach and accessibility, that has the most profound effect on civilizations (Burke, Briggs, 2005). Arguably, mobile technology, ranging from mobile devices, augmented reality devices, cellular phones, SMS and electronic learning portals can help to provide students, learners, and educators with a tactile tool that facilitates learning and the acquisition of knowledge at a moments notice (Nedungadi, 2012). Therefore, this paper investigates the paradigm shift that is changing our world to an anywhere anytime learning space and the broad and specific implications that those tools offer to the field of education and learning. The structure of the rest of this paper will be based on several main ideas and that will be expanded to reflect and illustrate the ways mobile technology is affecting learning and education.

1. Mobile Technology

Mobile technology and learning is in the tech and education domain, the new catchphrase; however, what exactly does mobile technology imply and where is this

technology heading? While studies with these devices are still relatively new, some researchers are suggesting that, as high as 87.2% of educators have an "intention to adopt m-learning in American higher education" (Cheon, Lee, Crooks, Song, 2012). Therefore it is important to detail the specifics of mobile technology, providing data and analysis for the uninitiated to examine and exemplify the general overarching models and illustrative uses of mobile technology. Essentially, the question 'where mobile technology is heading?' links to an amalgamation of ideas and innovations from: electronic learning, mobile learning, and how teachers, students and learners interact with and utilize influential tools and ideas in a rapidly evolving global learning environment. However, there are some drawbacks with mobile technology. Arguably, mobile technology affords greater difficulty in reading text on a mobile device screen than on paper. There are limitations in presenting graphical information with complex image and of large size and increased challenges to interactivity without a mouse and a keyboard, as well as small screen size (Ting, 2012).

Nevertheless, the rapid proliferation of mobile technology has resulted in a present day reality where most students, parents or teachers have access to a mobile device. The capacity of mobile technology has advanced with an explosion in the number of devices that can now access the Internet and perform a multitude of complex functions (Nedungadi, 2012). In general, mobile technologies' low cost, transportability, and anytime anywhere access give it an edge over the computer lab setup. Moreover, most learners and educators are challenged by finding the right adaptive learning system that can be integrated seamlessly: "The m-learning approach allows similar supplementary learning to be provided to schools that cannot afford expensive computer labs" (Nedungadi, 2012). That is, m-learning is affordable and easily personalized.

2. Adaptive Learning

Adaptive learning on mobile devices is utilized in a multitude of domains. For example, cloud-based learning is essential for mobile devices because data and course content can be hosted on a online server, student and teachers can then access that content online or through a mobile device. Cloud-based systems also help to facilitate distance-based learning, where learners do not need to be in a physical classroom and can upload videos of class instruction or uplink to live classrooms hosted online servers (Goh, Hooper, 2007). Adaptive learning systems that incorporated mobile devices are quickly influencing the m-learning sphere (Goh, Hooper, 2007). These systems provide teachers with real-time feedback about individual and group learners and provided personalized learning content recommendations based on users knowledge-levels. According to Nedungadi, the use of an Adaptive Learning and Assessment System (ALAS) to gain empirical analysis of student performance, perception and achievement, ultimately illustrates that learners can seamlessly move between, from the standard desktop computer-style electronic learning, to mobile (cellular/tablet) m-learning systems without significantly affecting the learning outcomes (Nedungadi, 2012). Furthermore, mobile technology allows educators to monitor both individual and group performances irrespective of the end-learning environment used. Therefore, m-learning's functionality as a learning instrument assists in facilitating a rapid transferability of feedback, knowledge, and adaptive content through a learner-based environment (Nedungadi, 2012).

3. Connectivity

More than ever, humans are now connected to an online meshwork of global content. Educators and researchers alike are pointing out the fact that the rapid heterogeneity of devices that can now access the Internet is necessitating the development of mobile applications and functionalities. This is becoming a worldwide trend due to the ease of access to inexpensive mobile technology that has created a more connected and global world than ever before. Researchers have revealed that introducing mobile devices into conventional classes revolutionized the way students learned English as well as "extending the scope of teaching and participation outside the classroom" (Lin, Shuying, Weili, Xiaohan, 2011). M-learning research studies help to shed light on the specifics of mobile technology that enable this digital trend to

effectively facilitate learning. Researchers focused on specific devices functionality "to explore real physical environments linked to digital guides; provide real-time feedback; discussion with peers, or synchronously, audio or text; recording, capturing data, sounds, images, videos, text, locations, building, making, modeling, using captured data and digital tools; sharing, captured data, digital products of building and modeling; and adapting the products developed, in light of feedback from tests or comments" (Lin, Shuying, Weili, Xiaohan, 2011).

While all these functions are accessible in conventional e-learning, what makes this particular study so unique is its integrated results and framework.

Furthermore, the interactivity of mobile technology is not to be underestimated. The remarkable feature of going mobile is that it provides students with instantaneous connectivity. The old method of classroom design is based on note taking; however, in the mobile learning design framework, students are able to access knowledge instantaneously and share it via message boards, and the educator's hosted websites. (Lin, Shuying, Weili, Xiaohan, 2011). Using mobile technology tackles many challenges that teachers face. Arguably creating a farther-reaching and more direct experience that those students can learn from and relate to in that mobile technology is ultimately promoting effective learning. Mobile learning can provide students with continuous access to materials and allows for a fast and easy feedback structure between learners and instructors. The ease and deliverability of mobile technology is an essential tool that makes many classroom tasks very simple freeing up more time for class discussion and innovative learning (Holotescu, Grosseck, 2012).

4. Collaboration, Feedback & Rapid Transferability

As mobile technology expands the cost, its ease of accessibility has also increased, thereby allowing a rapid and inexpensive spread of technology and connectivity. Mobile technologies' rapid development and functionality helps it to link seamlessly with student collaboration (Park, 2011) M-learners can benefit from a high degree of collaboration by making connections to other learners and learning content instantly mediated by a mobile device. This often-reported high level of networking creates shared, and socially interactive environments. So m-learners can readily communicate multi-modally with peers, teachers and other experts, and exchange information (Kearney, Schuck, Burden, Aubusson, 2012). That is, learners consume, produce and exchange content, sharing information across platforms and learning environments. This exchange is invaluable to the m-learning experience and creates a spontaneity that is made possible via accessibility, and anywhere anytime access.

As mentioned previously, one of the greatest assets m-learning provides is a rapid access to feedback. Mobile technology's abilities are providing anywhere anytime learning with broad reach and access, in conjunction with student feedback, and illustrate how supportive mobile applications can play a fundamental role in changing the way humans synthesize knowledge. According to the Changchun study, teacher and student feedback is a key ingredient in the benefits of mobile learning environments (Lin, Shuying, Weili, Xiaohan, 2011). The advent of mobile technology has provided alternatives for people to learn and teach without the limits of time and space. The prevalence of mobile phones among college students illustrates how m-learning is a promising and innovative educational tool, particularly in the instruction of English as a foreign language (Liwei, San-Nan, 2011).

5. Feedback Modalities

Another mobile learning study built one system that allowed the construction of tests and surveys online that were available to the learners, and another system that allowed students to use mobile phones to create their own content (Reis, Escudeiro, 2012). The researchers found that both testing strategies were integrated quickly and were enjoyed by both students and teachers allowing students to acquire knowledge far better than conventional testing and note taking (Reis, Escudeiro, 2012). According to the study, the researchers planned a set of learning activities in order to assess the influence of mobile learning in engaging students in activities. The results led to the conclusion that, the use of mobile phones in the classroom, enables a better understanding of concepts which increase students' comprehension skills, access to information and, the students can take notes faster (Reis,

Escudeiro, 2012). That is, the mobile learning module design not only increased comprehension, and access to information, but also increased student retention and note taking speed. Therefore, this study illustrates how m-learning feedback has a great potential to be used in higher education, and demonstrates how an adaptive system was well accepted by both the students and teachers.

6. Limitations

Nevertheless while this paper seeks to shed light on the benefits of mobile technology and it's capabilities, it is also important to note the pit falls and limitations of mobile learning. The main arguments from many researchers that arise with mobile technology are as follows:

- Greater difficulty in reading text on a mobile device screen than on paper;
- Limitations in presenting graphical information with complex image and of large size; and
- Increased challenges to interactivity without a mouse and a keyboard, as well as small screen size (Ting, 2012).

While the research points out that, these drawbacks are more often than not related to the user's comfort and familiarity with technology, perhaps the way to overcoming pitfalls of mobile devices are to provide students with a positive experience in using mobile devices for learning (Ting, 2012). This approach duplicates a gradual change from general usability research to focus on ease – making mobile devices easy to learn from and easy to use (Ting, 2012). This approach illustrated by Kukulska, Hulme, and Shield points out an interest in the user's emotions, which encompasses a wider set of concerns such as satisfaction, experience, enjoyment, and helpfulness (Kukulska, Hulme, Shield, 2004). Arguably emotions play one of the highest roles in users' experience and act as a handmaiden to learners' reception of new technology and the technological ability to achieve its function. In other words, "There is a balance to strike between providing a truly flexible and interpretative approach to emotional expression in the classroom and supporting easy interpretation" (Balaam, Fitzpatrick, Good, Luckin, 2010). This means that in the case of mobile technology and Augmented Reality tools, the goal is not to frustrate the end user, but rather to create a balance with room for individual interpretation, expression, ease of use, rapid proliferation of knowledge, and prompt feedback (Bates, 2012). Mobile technology is still seeking to bridge the gap between emotion and usability challenges. That is, there is room for mobile technology to address superior ways to use application creation to address the challenges and emotional expression of learners that are tied with going mobile (Isomursu, Tähti, Väinämö, & Kuutti, 2007). Therefore, overcoming the design interface of mobile technology can perhaps be further addressed in later studies through examining human emotion and how emotion relates to the adaptation of novel technology. Thus, it is likely that the two modalities emotion and Adoption can coalesce into new forms of anywhere anytime learning with the right amount of equilibrium.

7. Bridging the Gap: Augmented Reality

A groundbreaking form of mobile adaptation that combines engagement with rapidly developing technology is Augmented Reality (AR). AR technology is not a new issue. "It has been used in fields such as: military; medicine; engineering design; robotic; telerobotic; manufacturing, maintenance and repair applications; consumer design; psychological treatments" (Mehmet, Yasin, 2012). That being said, AR is also constantly evolving and is now at the forefront of innovative tools that can enhance educational content, and can create new types of automated applications to enhance the effectiveness and attractiveness of teaching and learning for students in real life scenarios. While educational studies on AR are severely limited, the technology has finally reached a scalable possibility that its propagation can be used and acquired by educators and learners with relative ease. Similar studies have been conducted with Quick Response Codes (QR). These QR codes studies have illustrated that the "strength of mobile learning is to link e-learning content with specific locations in which that information will be applied" (Macdonald, Chiu, 2011). Augmented reality takes location 'tagging' and interaction to a new level according to behavior science studies conducted with AR.

"AR technology augments virtual information on the top of real world with continuous and implicit user control of the

point of view and interactivity. It provides a composite view for the user with a combination of the real scene viewed by the user and computer generated virtual scenes. This is an augmentation of real world by engaging an ordinary place, space, thing or event in a way that is partly unmediated. This new approach enhances the effectiveness and attractiveness of teaching and learning. The ability to overlay computer generated virtual things onto the real world changes the way we interact and trainings becomes real that can be seen in real time rather than a static experience" (Mehmet, Yasin, 2012).

In other words, AR brings virtual reality through a smart phone (most smart phones now have this capability) or any relevant device, and can host virtual content onto a real world space, as shown in Figure 1 below.

This example of an AR overlay hosting illustrates and conjoins e-learning with m-learning. That is, by hosting content online via a personal computer and then access the content via mobile devices, this interaction enriches the user experience fulfilling a completely novel level of user interactivity and engagement. Thus, the possibilities for this technology combined with education and learning are almost endless. Research conducted with handheld displays and mobile technology illustrate how AR can revolutionize the way of humans interact and absorb learning content in day to day life and in learning environments (Mehmet, Yasin, 2012). AR can be applied to learning and edutainment by enhancing a user's perception of and interaction with the real world. Learners

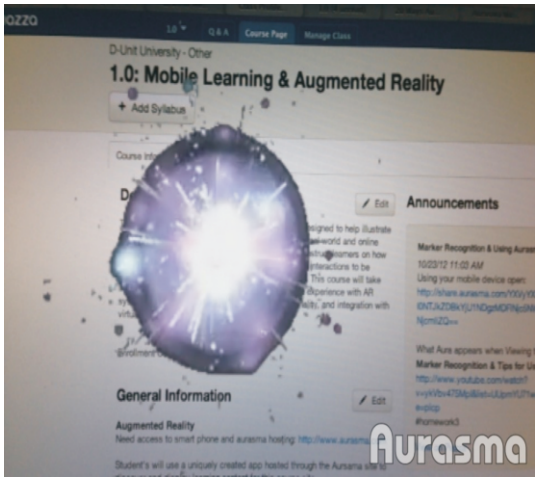

Figure 1. Students "tag" Augmented Reality content using a mobile application called Aurasma in an online classroom

interact with three-dimensional virtual image and view it from any vantage point, just like a real object. "The information conveyed by the virtual objects help users to perform real- world tasks (Mehmet, Yasin, 2012). That is, the notion of a 'Tangible Interface Metaphor' is one of the important ways to improve learning and make the impossible as possible. By hosting augmented overlays and 3-D content onto learning management platforms and online hosting sites, users anywhere in the world can create and share their own digital tags and ideas: "By properly connecting these nodes with 3D objects, one can animate (e.g., move) objects. Other sensors are useful in managing user interaction, generating events as the user moves through the world or when the user interacts with some input device" (Luca, Roberto). Mobile technology can now service as the input device is retrieving hosted content from an online learning management database and displaying this content for a learning to digest, interact, engage within real-time.

AR systems are powerful tools that can help bridge the gap between student enjoyment, mobile technologies affecting responses, and direct learning experiences: "When we interact with an environment, be this real or virtual, our type of experience is a first- person; one that is a direct, non-reflective" (Winn, 1993). Ultimately, AR is a direct response to first person content that ties fundamental virtual subject matter to the real learning objects, images, and locations.

Conclusion and Implications

Mobile technologies' rapid proliferation as an adaptive learning tool, its connectivity, useful contribution to collaboration and feedback help to illustrate how this tool is evolving and enhancing the way of humans to learn and share ideas. Mobile's uses in the classroom as means of rapid feedback, anywhere anytime access, and its use as a transition tool from computer based learning to mobile device learning helps to exemplify this point. The implication for mobile technology in the education sphere is almost endless. Combined with Augmented Reality and 3-D web hosting, mobile learning, anytime anywhere education is becoming a reality. Mobile technology is one of the fastest developing communication tools in the

history of humankind (DeGusta, 2012). Perhaps now more than ever, one of the biggest questions what educators and instructors face is how to engage learners in the digital age as technology rapidly evolves. However, the idea of 'flipping the classroom', thereby allowing students the-anywhere-anytime access to education can often be an essential tool for educators all over the world (West, 2013). The rapid spread of mobile learning is due to its ease of use and socio-economic benefits (Caballe, 2010). Mobile technology has evolved to enable learning to take place at any time in any location. This ease of access is revolutionary and can be highly motivating and engaging for learners (Mehmet, K., & Yasin, O. 2012).

Additionally, increased access and lowered costs enable learners worldwide to access content and information that would be unavailable through conventional methods. Essentially, mobile technology enables educators to provide an adaptive and motivating learning experience relevant to the learners' location and context. Feedback can be easily sent directly to learners and teachers enabling quick acknowledgement and follow-ups (Lin, Shuying, Weili, Xiaohan, 2011). Early adopters of mobile technology have seen huge gains in classroom feedback, student engagement, and collaboration. Education is now in a cycle of change and innovation. As mobile technology has expanded worldwide, it has its many uses Mobile technology is being utilized as a primary source for learning and information (Saechao, 2012). Mobile applications have transformed the field in which educators can operate and implement learning content. Many classrooms now solely utilize mobile technology to access content and to distribute materials, saving time and costs (West, 2013).

The mobile device is a compelling platform for educators to utilize in conjunction with e-learning allowing learners to have continuous access to the latest course and learning content. Students and educators are able to connect with each other anywhere and at any time to discuss and explore their learning together thereby redefining the traditional roles of classroom education. Moreover, as we see the end of textbooks and the explosion of online learning, mobile technology will be a massive advantage for early adopters and e-learning educators. By adopting technology planning strategies and skills to develop m-learning and e-learning tools, educators will be better equipped for the evolving technology infrastructure.

Mobile learning can provide students with continuous access to materials and allows for a fast and easy feedback structure between learners and instructors. The ease and deliverability of mobile technology is an essential tool that makes many classroom tasks very simple freeing up more time for class discussion and innovative learning. Furthermore, as mobile technology expands, the cost and ease of accessibility has also increased, thereby allowing a rapid and inexpensive spread of technological connectivity and enabling scalable innovations such as Augmented Reality. Students engaged in learning that incorporates multimodal designs, on average, have been shown to outperform students who use traditional approaches (Nedungadi, 2012). Moreover, Mobile utilization and creation will help instructors in the long run to accomplish learning outcomes that in past would have been impossible.

While future research and development for mobile learning looks promising, some key factors to focus on are: the research and development of interactive design (such as AR), emotion integration (how to display and detect human emotion using a mobile device), and mobile connectivity (ease of access to internet and users worldwide). Rapidly connecting people with ideas and learning solutions offers an amazing window into the imminent future of online and mobile learning. These future portents an environment where learners might interact, implement, and design mobile interactions, applications and AR overlays, to be utilized in real world and online learning environments. Ultimately, mobile technology shows potential for learning environments all over the world. The capability, connectivity and the explosion of information technology illustrates that a future of Augmented Reality, mobile feedback, and anywhere anytime learning is an approaching certainty for learning and education in the future.

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