A Study of Delivering Education through Mobile Learning

Regin Joy Conejar, Hyun Suk Chung and Haeng-Kon Kim

***Abstract*— Mobile learning through the use of wireless mobile technology allows anyone to access information and learning materials from anywhere and at anytime. Mobile learning, through the use of mobile technology, will allow citizens of the world to access learning materials and information from anywhere and at anytime. With mobile learning, learners will be empowered since they can learn whenever and wherever they want. They can use the wireless mobile technology for formal and informal learning where they can access additional and personalized learning materials from the Internet or from the host organization. This paper is timely since there is significant growth in the use of mobile technology by people around the world, especially in developing countries. This paper shows how mobile learning can transform the delivery of education and training.**

***Index Terms*—mobile learning, mobile technology, e-learning, education**

I. INTRODUCTION

A major benefit of using wireless mobile technology is to reach people who live in remote locations where there are no schools, teachers, or libraries. Mobile technology can be used to deliver instruction and information to these remote regions without having people leave their geographic areas. This will benefit communities in such places since students and workers will not have to leave their families and jobs to go to a different location to learn or to access information. At the same time, business owners, agriculture workers, and other working sectors can access information to increase productivity and improve the quality of their products. People living in remote communities will be able to access health information to improve their health hence, enhancing quality of life. Finally, because remote access using wireless mobile technology reduces the need for travel, its use can reduce humanity's carbon footprint on earth to help maintain a cleaner environment.

Educational technology has combined these approaches, and has accelerated education's future trajectory greatly. It is an exciting time to be involved in the educational sector, regardless of your role.

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The revolution in Education does not just affect the way in which students learn – this particular paradigm shift reverberates significantly deeper than that. It affects the way teachers teach, the way schools are structured, the barriers between school and home life, and – perhaps on its most profound level – affects the trajectory of the entire future of humanity.

The global future of mankind in these modern, changing times is uncertain, unstable, and dynamic. In order for future generations to adapt to such uncertainty, and create sustainability, it is vital that the way in which we teach them to do so can also adapt with equal dynamism. This is not the case with the "old" educational paradigms.

Technology has changed our world in ways previously unimaginable. Mobile devices permeate our daily lives, providing unparalleled access to communication and information. Looking towards the next decade and beyond, it seems clear that the future of mobile learning lies in a world where technology is more accessible, affordable and connected than it is today. However, technology alone, regardless of its ubiquity and utility, will not determine whether mobile learning benefits large numbers of people. Designing effective mobile learning interventions requires a holistic understanding of how technology intersects with social, cultural and, increasingly, commercial factors. The technology itself is undeniably important, but equally if not more important is how people use and view technology, a point that has been largely overlooked. Just because mobile devices carry a potential to, say, help improve the literacy skills of women in resource-poor communities does not mean that these devices will actually be employed towards this end. Indeed, across the world women are far less likely than men to own and use mobile devices, and in many communities women are discouraged from using mobile technology for any purpose, learning included. Mobile devices are often banned from schools and other centers of education, despite considerable and, in many instances, well-established potential to enhance learning. Such bans project a view that mobile devices are antithetical to learning, and this outlook, regardless of its factual validity, impacts the way people interact with technology. Over the next fifteen years, the implementation of mobile learning projects and the pedagogical models they adopt should be guided not only by the advantages and limitations of mobile technologies but also by an awareness of how these technologies fit into the broader social and cultural fabric of communities.

The use of wireless, mobile, portable, and handheld devices are gradually increasing and diversifying across every sector of education, and across both the developed and developing worlds. It is gradually moving from small-scale, short-term trials to larger more sustained and blended deployment. Recent publications, projects, and trials are drawn upon to explore the possible future and nature of

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mobile education. This chapter concludes with an examination of the relationship between the challenges of rigorous and appropriate evaluation of mobile education and the challenges of embedding and mainstreaming mobile education within formal institutional education.

Mobile technologies also alter the nature of work (the driving force behind much education and most training), especially of knowledge work. Mobile technologies alter the balance between training and performance support, especially for many knowledge workers. This means that "mobile" is not merely a new adjective qualifying the timeless concept of "learning"; rather, "mobile learning" is emerging as an entirely new and distinct concept alongside the mobile workforce and the connected society.

Mobile devices create not only new forms of knowledge and new ways of accessing it, but also create new forms of art and performance, and new ways of accessing them (such as music videos designed and sold for *iPods*). Mobile devices are creating new forms of commerce and economic activity as well. So mobile learning is not about "mobile" as previously understood, or about "learning" as previously understood, but part of a new mobile conception of society. (This may contrast with technology enhanced learning or technology supported, both of which give the impression that technology does something to learning). Rather than acquiring another technology to receive learning materials, people throughout the world will want to access learning materials on their existing mobile devices.

II. RELATED WORKS

A. Advances in Mobile Learning

The mobile learning currently exploits both handheld computers and mobile telephones and other devices that draw on the same set of functionalities. Mobile learning using handheld computers is obviously relatively immature in terms of both its technologies and its pedagogies, but is developing rapidly [1].

Furthermore, defining mobile learning can emphasize those unique attributes that position it within informal learning, rather than formal. These attributes place much mobile learning at odds with formal learning (with its cohorts, courses, semesters, assessments, and campuses) and with its monitoring and evaluation regimes. The difference also raises concerns for the nature of any large-scale and sustained deployment and the extent to which the unique attributes of mobile learning may be lost or compromised. Looking at mobile learning in a wider context, we have to recognize that mobile, personal, and wireless devices are now radically transforming societal notions of discourse and knowledge, and are responsible for new forms of art, employment, language, commerce, deprivation, and crime, as well as learning. With increased popular access to information and knowledge anywhere, anytime, the role of education, perhaps especially formal education, is challenged and the relationships between education, society, and technology are now more dynamic than ever. This chapter explores and articulates these issues and the connections between them specifically in the context of the wider and sustained development of mobile learning.

B. Game-Based Learning

Young people have played computer and online games with enthusiasm and persistence since the 1960s and 1990s, respectively. Now computer and online games are more prolific and popular than ever before. Educational institutions, as a result of having mobile learning device initiatives and cloud computing, are harnessing the same determination, enthusiasm and persistence that are brought out of students when they play games. Cardiff teacher Gareth Ritter explains how *"a lot of the kids in [this] school play Call of Duty. If they fail a level they won't give up, they'll keep doing it. We've got to bring that into the classroom"* (Vasagar, 2012) [2]. Game-based learning seems likely to become the most effective way to teach students fundamental concepts which would have previously been learnt via repetition and written exercises.

C. Virtual and Remote Learning Platforms

New, previously unimaginable possibilities for learning environments are also resulting from the merging of our physical and virtual world. The classroom is no longer restricted to existing inside a physical educational institution; it can be anywhere the student chooses. This is the idea encapsulated by VLEs. At the forefront of this idea are virtual and remote learning platforms. As mentioned above, VLEs are educational electronic learning systems based on online models that mimic conventional in-person education. VLEs can include most learning environments from virtual learning platforms like those of MOOCs to virtual worlds like those used for game-based learning [3]. Virtual and remote learning platforms are poised to provide any student within or outside of traditional educational infrastructure with an engaging and interactive learning environment.

D. Mobile Learning Frame Model

In the FRAME model, mobile learning experiences are viewed as existing within a context of information. Collectively and individually, learners consume and create information. The interaction with information is mediated through technology. It is through the complexities of this kind of interaction that information becomes meaningful and useful. Within this context of information, the FRAME model is represented by a Venn diagram in which three aspects intersect (Figure 1).

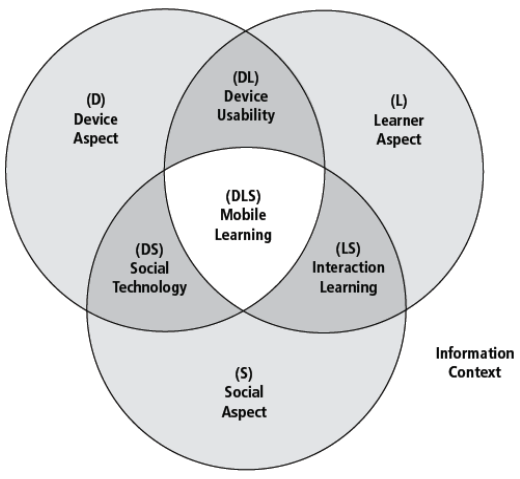

Fig. 1. The Frame model

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The three circles represent the device (D), learner (L), and social (S) spects. The intersections where two circles overlap contain attributes that belong to both aspects. The attributes of the device usability (DL) and social technology (DS) intersections describe the *affordances* of mobile technology (Norman 1999). The intersection labelled interaction learning (LS) contains instructional and learning theories with an emphasis on social constructivism. All three aspects overlap at the primary intersection (DLS) in the centre of the Venn diagram. Hypothetically, the primary intersection, a convergence of all three aspects, defines an ideal mobile learning situation. By assessing the degree to which all the areas of the FRAME model are utilized within a mobile learning situation, practitioners may use the model to design more effective mobile learning experiences.

E. Towards More Effective Mobile Learning Environments

While learners may not actually share the same physical environment, they can use mobile devices to share aspects of their personal and cultural lives. To solve problems unique to their situations, learners can readily choose from a seemingly unlimited quantity of data. The Internet has ushered in an era in which information has become easy to access and easy to publish. Now, learners must acquire the skills and tools to navigate through this growing body of information [4]. Mobile learning enables learners to interact using additional tools such as text messaging, mobile Internet access, and voice communications – all through wireless networks. Although this medium may be hindered by low bandwidth and limited input and output capabilities, there are some distinct advantages:

- Wireless, networked mobile devices can enable learners to access relevant information when and where it is needed. Mobile learners can travel to unique locations, physically *with* or virtually *through* their mobile devices.

- The ability to access a variety of materials from anywhere at anytime can provide multiple cues for comprehension and retention.

-Learning within specific contexts can provide authentic cultural and environmental cues for understanding the *uses* of information which may enhance encoding and recall.

- Well-implemented mobile education can assist in the reduction of cognitive load for learners. While it is difficult to determine how to chunk information, differing patterns of presentation and amounts of information can potentially help learners to retain, retrieve, and transfer information when needed.

III. THE CURRENT STATE OF MOBILE LEARNING

Today, mobile technologies – originally marketed mainly as communication and entertainment devices – have come to play a significant role in economies and society at large. Mobile devices have impacted nearly every field, from banking to politics, and are currently being used to increase productivity in numerous sectors. As these devices become increasingly prominent worldwide, there is a great deal of excitement building around mobile learning. Students and teachers are already using mobile technologies in diverse contexts for a wide variety of teaching and learning purposes, and key educational players – from national education ministries to local school districts – are experimenting with supportive policies to promote innovative mobile learning in both formal and informal education settings. Many of the experts interviewed for this report feel that mobile learning is now on the threshold of a more systematic integration with education both in and outside of schools. Decisions made today will fundamentally influence the character of mobile learning in years to come. To help set the stage for these decisions, the following sections outline some of the most prevalent trends in mobile learning to date. These include innovations in formal and informal education, seamless learning and educational technology.

A. Formal Education

The presence of mobile devices in formal education systems is growing. Globally, two of the most popular models for mobile learning in schools are one-to-one (1:1) programmers, through which all students are supplied with their own device at no cost to the learners or their families; and Bring Your Own Device (BYOD) initiatives, which rely on the prevalence of learner-owned devices, with schools supplying or subsidizing devices for students who cannot afford them. As might be expected, the 1:1 model tends to be more common in poorer countries and regions, while the BYOD strategy is usually implemented in wealthier communities where mobile device ownership among young people is nearly ubiquitous.

B. Bring Your Own Device (BYOD)

One viable way achieve a 1:1 environment is to have students use the mobile devices they already own. This model, known as BYOD, is already causing a major shift in higher education and distance learning by allowing more students to access course materials via mobile technology. As mobile access and ownership increases, BYOD holds promise for learners around the world, although it may look drastically different across various regions and countries. While the strategy has been most popular in countries and communities where smartphone and tablet ownership is widespread, learners and educators have also found ways to capitalize on less sophisticated student-owned technologies. The Nokia MoMath project in South Africa, for example, uses the SMS (Short Message Service) features on standard mobile phones to provide students with access to mathematics content and support (Isaacs, 2012*b*).

While BYOD moves the hardware costs from the school to the learner, it places additional pressure on bandwidth – a critical infrastructure consideration for mobile learning initiatives. Schools or governments implementing BYOD programs must also have a strategy in place to provide devices to students who cannot afford them, either by buying the devices for the students or subsidizing their purchase. Further issues include security, privacy, adequate professional development for teachers, and a digital divide between students with cutting edge devices and those with less powerful devices or none at all. For these reasons, examples of successful BYOD initiatives, particularly in primary and secondary institutions, are limited. However, as sophisticated mobile technologies become increasingly accessible and affordable, BYOD may form a central component of mobile learning projects in the future (Norris and Soloway, 2011).

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C. Informal Education

Mobile learning has developed, to a large extent, outside of formal education contexts, and the vast majority of mobile learning projects are designed for informal learning.

D. Informal Education

Seamless learning is defined as uninterrupted learning across different environments, including formal and informal settings. In the ideal seamless learning scenario, a learner opportunistically uses various kinds of technologies, capitalizing on the unique affordances of each- the mobility of a smartphones, for example or the superior keyboard on a desktop computer – to maintain continuity of the learning experience across a variety of devices and settings. Historically, there has been a significant divide between the formal learning that happens inside a classroom and the informal learning that occurs at home or in community environments. Numerous experts are investigating how mobile learning might help break down that barrier and bridge the gap between formal and informal learning.

E. Educational Technology

Recent innovations in mobile technologies have mostly centered around the creation of digital content, largely in the form of digital textbooks accessed via e-readers, and the development of mobile applications (apps) and software platforms for accessing educational resources via mobile devices.

Digital Textbooks and E-Readers

In formal education settings in the developed world, the transition to digital textbooks is one of the most established mobile learning trends. As e-readers and e-reading applications continue to improve, the experience of reading electronically is rapidly becoming more pleasurable and conducive to learning. New approaches to textbook conversion and creation are moving away from mere digital reproductions of printed text to visually rich interfaces that can include multimedia, interactive and collaborative elements (GSMA, 2011).

The next generation of e-readers and tablets will offer new possibilities for teaching and learning. For example, e-books could enable a more social form of study, with a group of students collaborating to read, annotate and compare one or more texts on the same topic, each working from their individual mobile device (Sharples et al., 2012). Future e-books could exploit the tools built into mobile devices – such as voice recorder, camera, timer, GPS (Global Positioning System) locator, accelerometer, compass and tilt sensor – for exploratory learning, guiding the reader through experiments like testing the properties of light using the device's camera or sound using the recorder (Sharples et al., 2012). As tablet and e-reader technologies improve in quality and decrease in price, this movement towards digital textbooks could increase educational opportunities for learners around the world, particularly those who do not currently have access to high-quality physical materials [3].

Mobile Apps

Marketplaces for mobile apps have provided an entirely new distribution mechanism for content, stimulating substantial investment in software development for mobile devices. Educational apps are already experiencing significant growth in developed countries. These apps provide new tools for educational activities such as annotation, calculation, composition and content creation. A recent study found that 270 million apps linked to education were downloaded in 2011 – a more than tenfold increase since 2009 (McKinsey & Company and GSMA, 2012).

While a small number of educational apps are mapped to curriculum targets and designed for use in classroom or homework settings, the majority are intended mainly for informal learning (GSMA, 2011). However, as more students use mobile devices in formal education settings, apps will likely become an important part of the mobile learning ecosystem. Not only are developers now able to bypass institutions and sell content directly to learners, but students, teachers and schools alike will be able to make small, incremental investments in micro-sized pieces of content. For example, rather than investing in the same textbook set or software solution for an entire classroom, school, district or country, educators will be able to choose from a variety of apps that are tailored to each individual learner, powering the personalized learning that is expected to characterize formal education in the future.

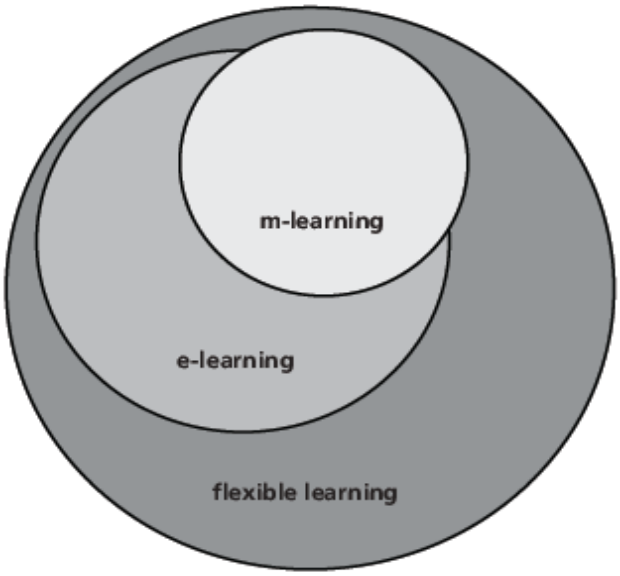

Fig. 2. Model of Flexible Learning

The advent of mobile technologies has created opportunities for delivery of learning via devices such as PDAs, mobile phones, laptops, and PC tablets (laptops designed with a handwriting interface). Collectively, this type of delivery is called m-learning. While m-learning can be thought of as a subset of e-learning (which is web-based delivery of content and learning management), the emerging potential of mobile technologies tends to indicate that m-learning, while mostly situated within the e-learning framework, also has links directly to the "just enough, just in time, just for me" model of flexible learning (see Figure 2), and is therefore just one of a suite of options that can be adapted to suit individual learning needs.

IV. THE FUTURE OF MOBILE LEARNING

With over 5.9 billion mobile phone subscriptions worldwide, mobile devices have already transformed the way we live. But even though people around the globe rely

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heavily on mobile technology, educators and policy-makers have yet to tap its full potential to improve learning. The next decade and beyond could be transformational in incorporating mobile technologies in both formal and informal education to better meet the needs of learners and teachers everywhere. The following sections describe some of the technological advances most likely to impact mobile learning in the future, and highlight key focus areas in the development of mobile learning over the next fifteen years.

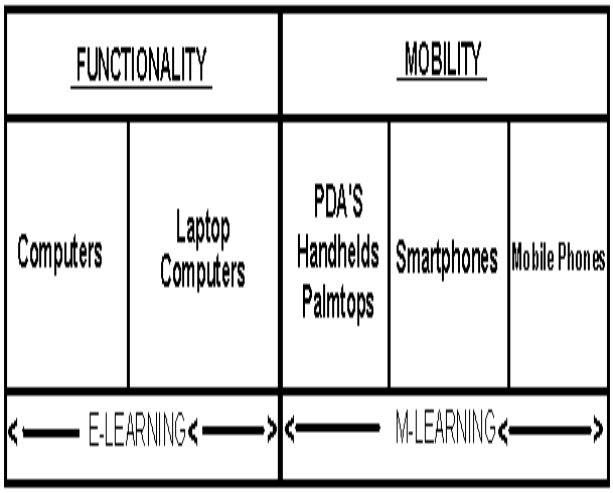

Fig. 3. Functionality and Mobility Definition of Mobile Learning

A. Technological Advances

In the next fifteen years, technology will change in numerous ways that can be leveraged for education. It is important that educators understand there innovations so as to influence their development rather than simple react to it. Ideally technology and education will co-evolve, with education needs driving technological progress as well as adapting to it. Outlined below are some of the technological advances most likely to impact teaching and learning from a global perspective.

B. Technology will be more accessible, affordable and functional

While unforeseen technological innovation is certain, the advances that will have the greatest impact on education will likely stem from a continuation of the current and most important trends in technology evolution – namely improved functionality, connectivity and memory at lower costs. Increased availability and penetration of 'smart' mobile devices and cloud-based services with advanced functionalities will open up a world of new possibilities for mobile learning solutions, allowing the types of initiatives that are currently happening to be replicated on a large scale. Many experts imagine a day where every learner in the world has access to a powerful touch-screen tablet device and can afford both the hardware and the connectivity that enables fast and seamless access to the internet and/or other networks.

C. Mobile Learning Focus Areas

In the next fifteen years, mobile learning will undoubtedly become more integrated with mainstream education. Just as computers are now viewed as crucial component to learning in the twenty-first century, mobile technologies will soon become commonplace in both formal and informal education, and gradually even the term 'mobile learning' will fall into disuse as it is increasingly associated with learning in a more holistic rather than specialized or peripheral sense. As the links between technical and pedagogical innovations improve, mobile technology will take on a clearly defined but increasingly essential role within the overall education ecosystem. The following sections outline the anticipated focus areas for mobile learning development in the foreseeable future.

V. THE FUTURE OF HIGHER Ed AND ITS IMPACT ON E-LEARNING

A. Trends Currently Affecting Teaching, Learning, and Creative Inquiry in Higher Education

- People expect to be able to work, learn, and study whenever and wherever they want to.
- The technologies we use are increasingly cloud-based, and our notions of IT support are decentralized.
- The world of work is increasingly collaborative, driving changes in the way student projects are structured.
- The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators.
- Education paradigms are shifting to include online learning, hybrid learning and collaborative models.
- There is a new emphasis in the classroom on more challenge-based and active learning.

B. Important Constraints and Challenges

1) Economic pressures and new models of education are bringing unprecedented competition to the traditional models of higher education.
2) Appropriate metrics of evaluation lag the emergence of new scholarly forms of authoring, publishing, and researching.
3) Digital media literacy continues its rise in importance as a key skill in every discipline and profession.
4) Institutional barriers present formidable challenges to moving forward in a constructive way with emerging technologies.

It is not surprising, therefore, that trainers, lecturers, distance education providers and teaching institutions at all levels are increasingly using the Web as a medium for delivery. Specifically and practically this study will map the evolution from the wired virtual learning environment of today, to the wireless learning environment of tomorrow.

VI. CONCLUSION

The use of mobile technology in education is a recent initiative due to the availability and rapid advancement of mobile devices such as smart phones, PDAs, and handheld computers. Recently, there have been many research studies and applications of mobile learning in both formal and informal learning. The chapters in this book present some of these recent studies and projects on mobile learning in education and training.

This study has focused on how technology is impacting the future of education. The impact of technology on education,

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however, is not reserved for the future; technology is currently innovating the ideas and methods of education. It seems to be a very exciting time to be a student, but the best thing about the technology discussed in this report is that it allows all of us to be a student, anywhere, at any age and at any time. There's no doubt about the fact that the realm of higher education worldwide is going to undergo a vast transformation. With newer and better technology becoming increasingly affordable, classrooms the world over are evolving. Through better understanding and utilization of these incredibly powerful new revelations in educational technology, we can prepare future generations for whatever may lie ahead.

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