

The Growing Use and Integration of Mobile Technology in Education: A Global Perspective



Chris Adams
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I. Mobile Technology in the Global Educational Arena

Throughout history, many civilizations have experienced the ebb and flow of global uprising and empire dissolution. Some achieved power through the assembly of military might, while others capitalized on fortuitous local commodities and trade routes. Without well-planned infrastructure or political shrewdness, however, success would inevitably turn to shambles. Today, the progress and economic empowerment of a nation's citizens is undeniably linked to academics. The top players in the new global economy all place a high value on education, with the idea that an erudite society can foster growth and achievement. Nelson Mandela famously declared that "education is the most powerful weapon which you can use to change the world." (Mandela) His sentiment seems both ambitious and optimistic, yet as education evolves, the ability to change the world is becoming more than just a romantic ideal. Unprecedented levels of technology have pervaded each corner of the globe, changing the way we both access and utilize information. Learning and technology have become inextricably linked and codependent. Mobile technology in particular has been the most powerful catalyst of change, redefining the educational approach and even the underlying concept of literacy.

The integration of technology into education has been gaining traction ever since the internet was invented. The powerful nature of the internet clearly lends itself to empowering both students and teachers, although the degree of appropriate curricular incorporation has been debated. E-Learning programs began appearing in classrooms in the 1990's, with forward-thinking educators touting the flexibility and efficacy of computer enhanced learning. Yet it is the emergence of mobile technology, including basic cellular phones and highly evolved tablet PC's with internet capability, that is clearly poised to permanently change the world's educational approach. The sheer ubiquity and firm embedment into everyday life has made it

impossible to ignore the possibilities that mobile learning offers. Indeed, the concept has been legitimized by the educational sector and is colloquially referred to as mLearning. mLearning is defined as any educational service that supplies a learner with general electronic information and educational content that aids their acquisition of knowledge, regardless of location or time. (Aderinoye et al.) This represents a true shift in instructional style, as mobile education is highly individualized and student-centered. It makes education a process of construction rather than instruction, and removes both the time and space constraints associated with customary classroom-based education.

The most exciting and beneficial application of mobile technology is its potential for international education, specifically in countries whose economies and infrastructures are still developing. Globally, the adult literacy rate currently hovers around 83%. 75% of those who remain illiterate reside in Southern Asia or sub-Saharan Africa. (UNESCO) Unfortunately, this lack of education is clearly tied to poverty, poor health, and lack of economic empowerment. In countries with literacy rates below 55%, average per capita income is approximately \$600. Conversely, countries with literacy rates above 90% report average per capita income of \$12,600. (SIL) Undoubtedly, efforts to increase universal literacy are necessary. Yet a significant barrier to improving the rate of literacy exists because the very definition of “literate” is dynamic, progressive, and an increasingly complex construction. As we become a more globalized and technologically based society, the historical and simplistic definition of “the ability to read, write, and have basic numeracy skills” (Ntiri) can no longer suffice. The Center for Literacy of Quebec states that “literacy in a technological society is expanding to include media and electronic text in addition to alphabets and numbers. Individuals must be given life-long learning opportunities to move along a continuum that includes reading, writing, critical

understanding and the decision-making abilities they need in their communities.” (Ntiri) As information transitions to the digital realm, technological competency is absolutely necessary to include in literacy programs.

Thus, two main benefits exist for utilizing mLearning in programs targeting illiteracy in underdeveloped areas. First is the ability to provide access to education when poverty constraints do not allow formal schooling. Second, and perhaps more important, is an exposure to the new technologies that are increasingly becoming an integral facet of a globalized economy. Ironically, the cost of integration is substantially lower than utilizing other technological avenues, as more and more people already have mobile devices ready to implement. In Asia, so-called “mobile penetration” is rapidly increasing. In 2001, approximately 20% of the population had mobile phones. By 2005, that number had doubled. (Valk et al.) In Niger, 40% of the country now has access to mobile coverage, and 10% of the population subscribes to a mobile device service. (Aker et al.) Africa overall represents the second largest and fastest growing mobile market in the world, with over half of Africans having a mobile subscription. Worldwide, there are now 5.3 billion mobile phone subscribers, with 450 million accessing the internet on their device. This number is expected to grow to over a billion by 2013. (UNESCO) Particularly striking is the mobile growth in developing countries as a whole: in 2005 people in the developing world represented just 53% of mobile subscribers, yet this share increased to 73% by 2010. (UNESCO)

This growth in mobile tech pervasiveness has given rise to programs attempting to exploit its potential. Goal 2 of the United Nations Millennium Development Goals aims to achieve universal primary education for children everywhere by 2015. (UNESCO) While this goal is still primarily supported by community literacy programs, numerous private corporations

and NGO's have started mLearning initiatives to improve literacy outcomes. Catholic Relief Services, an international NGO, began utilizing a program in Niger called ABC, or *Alphabetisation de Base par Cellulaire (Basic Literacy by Cell.)* In Niger, over 71% of the population over 15 years old was classified as illiterate in 2007. It is one of the poorest countries in the world, and ranks the absolute lowest in the UN's Human Development Index. (Aker et al.) ABC is part of an overarching literacy program in the country, and was tested on a sample population. ABC students used mobile phones and were taught how to send and receive Short Message Service (SMS) to complete a literacy teaching and assessment program. Both literacy and math scores were significantly higher in ABC villages. Additionally, 1 in 4 ABC students were able to achieve higher numeracy scores. (Aker)

Similarly, Tanzania has benefited from a project called Bridge IT. BridgeIT is an extension of the larger text2teach program developed for the Philippines. Used currently in 150 schools in Tanzania, the concept provides digital video content in classrooms and on-demand instructional material via text messages. (Trucano) Nokia, a cell phone manufacturer, has contributed numerous offerings to mLearning. Among the programs developed are Nokia Mobile Mathematics, Nokia Education Delivery, and Nokia Data Gathering. Additionally, they invented a Mobile FlashCard application to enhance literacy and language learning. Another mobile provider, France Telecom, developed an ongoing mobile learning project in conjunction with UNICEF, aimed at reducing global illiteracy. (UNESCO) These programs are quite recent in their implementation, none older than a decade, and identify a salient trend towards shifting from eLearning to mLearning. An analysis of six separate mLearning projects in Asia found that mobile learning presents a tangible benefit in addressing infrastructure challenges in remote areas, and is also cost-effective. Many developing countries are investing in the installation of

mobile phone networks and avoiding costly infrastructure associated with fixed telephone lines, as mobile phones operate on the radio spectrum. Further, the mLearning modules provide customized, learner-centered learning that allows students to take greater responsibility and participation in the learning process. mLearning also provides instant feedback by way of SMS assessment. (Valk et al.)

Technology is not only affecting educational offerings in remote areas, but also advancing well-established educational practices in fully developed countries. Numerous online learning modalities exist, and a shift towards accessing these resources on mobile devices is occurring. UNESCO estimates that within the next 5 years, more people will be accessing the internet on mobile devices than through fixed desktop computers. The trend towards individual educational empowerment is being reinforced by Open Educational Resources (OER) that aims to make education free, public, and accessible using technology. As the cache of online information and knowledge uploaded to the internet increases, so too does the power of a mobile internet device in regards to education.

A prominent OER example is that of KhanAcademy. Developed by Sal Khan as a solution to tutoring his niece over the internet, the website has exploded in popularity and has received support and funding from Bill Gates. Khan's mission statement is to make world-class, college-level education available to anyone, anywhere, free of charge. The site consists of module-based learning videos, usually around 10 minutes in length, and teaches subjects in sequential concept form. KhanAcademy also provides individual learning paths and instant testing feedback, and can be linked to instructor accounts for use as a supplement in classrooms. (KhanAcademy) Wikipedia is another widely cited OER example, with the mission of making all information free and accessible. There are currently over 19 million articles written in 270

languages, making global access possible. (Wikipedia.org) Even prestigious universities such as MIT and Carnegie Mellon have enacted content, offering Open Course Ware (OCW) that allows free and open access to university lectures and materials, enabling world-class learning in environments located nowhere near these institutions. (MIT) Beyond free and open courses, 75% of universities worldwide have online content in the works. By 2019, it is estimated that half of all classes taught will be online. In America alone there are 3 million strictly online-learning college students, suggesting clear interest and commitment to nontraditional educational methods. (onlineeducation.net)

While the mLearning phenomenon has apparently already gathered inertia, a few criticisms do exist. For one, virtually all of the technology has been produced in countries with an established baseline for tech literacy. Thus, assimilation to mobile devices may be difficult for extremely rural, tech-naïve areas. Teachers in Bangladesh, for example, have found that language barriers and unfamiliarity with advanced phone functions can impede mLearning progress. (Valk et al.) Also, mobile infrastructure directly impacts the quality of the experience, necessitating governmental assistance and support. (Valk et al.) Online and distance learning also fails to address the pivotal influence of teachers. Sometimes the complexity of material necessitates live instruction, and mLearning may deny students valuable mentoring experiences. Yet the obvious benefits and recognized enthusiasm for mobile learning suggests that it is worth pursuing. Technology holds the exciting promise of making education malleable and convenient, allowing students of all individual and economic levels to participate. Perhaps personal educational customization is mLearning's most powerful feature, where true global access to information may indeed be a catalyst for change.

II. Technology and Literacy in the Medical Field

A 1993 World Bank Development Report identified access to education, especially for girls, as being one of the most fundamental actions which could be taken to improve public health in the world's poorest countries. (Nutbeam) Numerous studies link education to higher levels of health, fertility, and life expectancy, as well as infant mortality rates. Education has an especially clear impact on women's health. A 2000 Save the Children report identified female literacy rates as one of the key indicators to assess women's well-being. Indeed, all countries ranked in the top 10 for women's well-being have female literacy rates of 90% or higher. A mother's education level also correlates closely with a child's risk of dying before age 2. (Cooper) Thus, improving health literacy is clearly a public and social obligation. Health literacy is defined as "the ability to read, understand, and act on health care information. It is the capacity to obtain, interpret, and understand basic health information and services and the competence to use such information and services to enhance health." (Kickbusch) Health literacy in developing nations approaches zero, and even in America only 1/3 of the population is health literate. (Nutbeam) However, as reliable and accurate medical information is now freely available online, technological literacy has become inexorably tied to health literacy. Accordingly, mobile technology is conducive to improving both healthcare education and delivery.

The field of medicine is a notably dynamic occupation. As treatment is based upon evidence and outcomes, clinicians adopt and absorb new practices throughout their careers. A central tenet of practicing medicine is to do what is best for your patient; therefore, any

advancement that improves efficacy and efficiency should be implemented. The past decade has seen the materialization of an entirely new market based upon consumer and provider healthcare applications. This sector has been termed mHealth. (Mishra) As a natural extension of mLearning, mHealth initiatives are likewise gaining traction in both high and low income countries. While not explicitly changing how a physician approaches the job, mobile technology does provide a way to enhance treatment compliance, data collection and disease surveillance, and the dissemination of health information. Further, mobile devices present an opportunity to decentralize health information systems. As many low-income countries depend upon community health workers and volunteers to receive care due to a lack of physicians, any modernization facilitating ease of access to patient records and instant consultation is valued.

An example of successful mHealth integration can be seen with St. Gabriel's hospital in western Malawi. Like many southern African countries, Malawi has suffered from the spread of HIV and also has poor outcomes with tuberculosis and influenza. St. Gabriel's serves a population of 250,000 people within a hundred mile radius. Despite this large demographic, the rural hospital only has two physicians on staff and must rely on community health workers (CHWs) to deliver much of the primary healthcare. In 2008, the hospital implemented a system called FrontlineSMS. One hundred of the CHWs were equipped with mobile phones, connected to a centralized computer program that can provide automated SMS replies and even track messaging via Google Maps. Besides enabling instantaneous communication for emergent care, the system also facilitated patient tracking, HIV medication adherence, and drug dosage information. The mobile phones used are recycled, the laptop was donated, and the ongoing costs associated with SMS use is only ten U.S. dollars per month. (Li et al.) Similarly, the Rwandan startup ResultsSMS implemented a program designed to distribute test results,

schedule appointments and follow-up, and facilitate patient education where healthcare access is typically unavailable. (resultssms.org) Such innovation highlights the effort to combat physician underrepresentation in rural Africa.

The benefits of mobile technology are not limited to low-income countries, however. Many recent applications have value unrelated to cultural, political, or economic differences. SimPill, for example, is a program designed to reduce the cost and complications associated with medication noncompliance. Successful treatment for diseases such as HIV, tuberculosis, and even bacterial infections depends largely on adherence to prescribed medicines. Patients worldwide seem to have trouble with compliance, and so SimPill seeks to address this concern. A small device attached to the bottom of the pill bottle text messages a central database each time the cap is removed; when the cap is not removed, the device instead sends a text message to the patient's mobile device reminding them to take their medication. (Michael et al.) Engineers in India have developed a unique system that uses a mobile phone to transmit a person's vital signs, including electrocardiograms, blood glucose levels, and blood pressure to a clinic anywhere in the world. (Mishra) Even the CDC has embraced mobile technology, developing interactive online content to help teach children basic healthcare concepts like managing asthma and coping with chronic diseases such as diabetes. (Cooper)

A concurrent trend in healthcare is the use of the internet and mobile devices to facilitate clinician training. As medical students are highly mobile and perform much of their training off-campus, mobile devices have naturally been found useful. SMS is widely and successfully used in both developed and developing countries to coordinate lectures, grand rounds, and tutorials. (Ellaway) Mobile phones are also increasingly becoming a resource and knowledge-bank. In both education and clinical practice, PDA's and smartphones are utilized to reference drug

dosing, procedural information, and even patient data. (Ellaway) This represents a significant shift away from using textbooks and paper-based reference materials. A further driver for implementing mobile phones in practice is the growth of globalized access to quality medical information. For example, the recent International Virtual Medical School project is a collaboration of fifty two medical schools from sixteen countries, with a focus on redefining e-learning in regards to medical education. While not intended to replace medical school, it allows undergraduate and didactic level courses to be completed online before entering into typical clinical education. (Harden)

While the integration of mobile technology in healthcare is clearly headed toward ubiquity, concerns do exist. Primarily, the issue of mobile device security has been scrutinized. Kathleen Sebelius, secretary of the U.S. Department of Human and Health Services, notes that most medical security violations are caused by access to sensitive records through unencrypted devices. Further, the mobile nature of PDA's and phones makes them easier to misplace. Data breaches in the U.S. have risen by 32% in the past year alone. (Dolan) Researchers at the Global Health and Economic Development Institute have other reservations. For one, mobile initiatives must consider differences in epidemiological profiles among varying geographical areas. For instance, medication compliance applications may only target therapies for communicable diseases that are rampant in areas such as Africa or Asia. Western countries, however, are largely afflicted with chronic, non-infectious diseases. Also, the success of any mobile initiative designed as a supportive entity is dependent upon the underlying health services framework. In essence, reminders to visit a clinic are worthless in the absence of reliable service and drug supply. The researchers also remained concerned with liability issues pertaining to accuracy of

disseminated information and the necessity for policy and guidelines regarding acceptable uses of mobile phones to treat patients. (Michael et al.)

Despite the setbacks, the broad implications of mHealth and its global scope of implementation make mobile technology a true tour de force. Although feedback regarding efficacy is still largely anecdotal, published literature considering mHealth's benefits is steadily increasing. In essence, there has never been a more exciting time to be involved in the medical field. Medicine excels in applying modern technology and ingenuity to complex problems. Despite the historical inequity between the global North and global South in receiving these applications, mobile technology gives the world a chance to narrow that divide. Expertise and superior medical proficiency is no longer constrained by time or place barriers. By taking advantage of mobile opportunities, health care practitioners worldwide can extend the reach of their services and contribute to the evolution of person-centered health care and well-being.

III. Integration of Mobile Technology in Iran

The burgeoning fields of mLearning and mHealth have taken root in nearly every corner of the globe, and Iran is no exception. The global trend toward using mobile technology to enhance education and healthcare has certainly effected a change in Iranian education; however, underlying cultural and political issues have retarded national implementation. A nationalized education program was not seen until 1925 with the advent of the Ministry of Education under Reza Shah Pahlavi. Prior to this, education was largely accomplished through religious institutions. Under Pahlavi rule, education was secularized and based upon the French model. Despite the effort, successful national education was not realized, with only 10% of children enrolled in elementary school and just 1% of Iranians between the ages of 12 and 20 enrolled in

secondary schooling in 1940. (Metz) A defining political moment for Iran came with the Islamic Revolution of 1979. Desecularization of schools was a major post-revolution initiative, and textbooks and teachers with ideas considered contradictory to Islamic tradition were purged. Unfortunately, a demand for secular education had blossomed. Several universities were host to violent clashes between students and government, and subsequently all major universities in Iran were shut down from 1980 until 1983. Upon reopening, the University of Tehran saw a reduction in enrolled students from 17,000 to just 4,500. Further, the percentage of women among total students dropped from 40% to just 10%. (Metz)

The tenuous relationship between Islamic customs and students seeking secular education has done little to promote educational opportunity and achievement. Nonetheless, efforts by NGO's and the Iranian government have clearly made a difference regarding health indicators and literacy rates among Iranian citizens. Iran has successfully reduced its infant mortality rate from 52 per 1000 births in 1990 to 28 per 1000. Preventative health measures have seen success, with reports of one year old children being immunized against measles rising from 85% in 1990 to 96% in 2001. Life expectancy has also increased 17.4% between 1986 and 2006. (Manesh) Perhaps most impressive is the overall literacy rate, rising from just 15.2% in 1955 to 84.6% in 2005. Especially encouraging is the fact that female literacy rose from a dismal 8% to 80.5% in the same time period. The number of women eligible for secondary school increased from 30 percent to almost 80% between 1980 and 2000. (Atashak et al.) Yet problems in Iranian education persist, embodied most significantly in the perception by middle and upper class Iranians that foreign education is superior to their own. (Metz) A large proportion of students choose to pursue higher education abroad, a practice discouraged by the government without success. An estimated 150,000 educated Iranians leave home each year to pursue better

opportunities in other countries. (Rajabi, Majdzadeh, Ziace) Such educational emigration is a major barrier to developing the economy and academic reputation of Iran.

It is interesting, then, to see how mobile technology that provides access to largely secular resources can shape education under a somewhat oppressive regime. The government has been less than enthusiastic about adopting mobile learning or even online learning programs, with only 13 of the more than 230 Iranian universities providing such opportunities in 2006. (Afzali et al.) However, enthusiasm and demand for online learning has forced universities to explore and experiment with mLearning. A number of top Iranian universities now provide mLearning modules, corresponding with increased mobile penetration in the country. There are now three mobile providers in Iran: Irancell Co., Mobile Communication Co., and Taliya Co. Proficiency with technologies such as Bluetooth and SMS is now widespread among Iranian youth, making the demand for mLearning higher than ever. (Afzali et al.)

One favored application of mLearning is foreign language training. One study examined the efficacy of using mobile phones to teach English, using vocabulary recall as a metric. Iranian English students in a control group were given mobile phones to see if this improved their retention of English vocabulary and grammar. The program utilized SMS to simulate flashcards and also to create interactive testing. Participants in the SMS group significantly outperformed those in the conventional control group. Further, the students demonstrated significant enthusiasm for learning in this manner. Instructors were receptive as well, noting the convenience of instant and digitized assessment. (Motallebzadeh)

The incidence of mLearning in college settings is also increasing. In 1991, online learning could only be found at Tehran University, which provided nine courses online. Now, the majority of Iran's universities offer online courses. The University of Hadith Sciences

currently provides the opportunity to attend general classes free of charge, possible mainly because all supplementary materials are published online. The University of Shiraz boasts access to their educational system through mobile phones, with teacher communication and student discussion taking place via text and chat. Most significant, however, is the decision of Iranian medical schools to consider mLearning. As many potential physicians seek their training out of the country, a movement toward the acceptance of secular learning may help re-internalize Iranian medical education. The Medical University of Tehran has the distinction of being the first medical science institution in Iran to adopt mobile learning, utilizing specially prepared textbooks for mobile devices and offering certain courses via mLearning. (Afzali et al.) And although not explicitly offering mobile learning for didactic courses, the Shaheed Behesti University of Medical Sciences has taken steps towards enhancing post-graduate clinician training. All healthcare providers are generally required to obtain Continuing Medical Education (CME) credits after entering the profession. Shaheed Behesti has recently implemented online CME training, removing the historical need to travel and attend foreign conferences to complete these requirements. (Forootan)

Despite the progress, barriers other than political interference do exist. First, the difficult and time-consuming process of producing digital content in the Persian language is a major limiting factor. Thus, much of the educational content is of unacceptable quality. This leads universities to use materials written in the English language, so an identifiable Western influence becomes an issue. Perhaps a more prominent obstacle exists in the reluctance of top university figures to support and endorse mobile technology, reflecting a cultural unwillingness to use nontraditional tools for education. This coincidentally causes a lack of qualified experts and professors who are proficient with mobile technology resources. Although international

standards have been propagated for mLearning standards, no such policy has been attempted within the country of Iran. Another barrier to widespread growth is general technological naïveté, making it difficult to realize the full potential of mobile resources. (Afzali et al.)

A research study seeking to identify the major trends and shifts occurring in Iranian medical schools found that distance and virtual learning are indeed becoming a permanent component of health science education. The increased access to information was noted as a major benefit; however, the study also clarified the potential reasoning behind feeble administrative support. One faculty member at the Medical University of Tehran noted “when I was a medical student, I learned a great deal from having face-to-face contact and close relationships with the great physicians who were my teachers, and seeing their humanistic manner with their patients. You can’t teach these things to students through virtual learning.” (Rajabi et al.) Other study participants were concerned that recent advances in information technology have allowed an enormous amount of information to become available, and this may overload and overwhelm students. (Rajabi et al.) These are legitimate concerns that point out the prospective pitfalls of widespread mLearning adoption. It may be necessary to preface modern medical education by teaching students how to effectively manage and navigate large volumes of information. Also, the value of hands-on experience and professorial mentoring cannot be disregarded, and these facets of education should not fade into extinction.

For better or worse, the Iranian Revolution has incited a palpable turbulence in the ideological identity of Iranian citizens. Despite difficulties with political transparency and democratic freedoms, a measurable gain in education and healthcare for the poor has been accomplished. Yet the struggle between Islamic traditions and the newly discovered freedoms that education has precipitated is a reminder that change does not always concur with culture. In

the future, the country of Iran and others like it will need to reconcile religious attitudes with an increasingly accessible cache of secular information. Hopefully the trend of higher learning institutions incorporating mobile resources, especially those offering medical education, can reverse the exodus of Iranian academics. Beyond formal education, the most romantic function of mobile technology is the empowerment of individuals to realize their own unique educational goals. Human curiosity should not be hindered by fiscal constraints, and the modern prospect of free, accessible information holds the promise of an unparalleled level of equality among nations. The advent of informed consumers, skilled health providers, and customized mobile learning may be a legitimate solution for introducing all countries to the new globalized economy without sacrificing generations of customs and culture. Like it or not, the future may view cell phones as less of a classroom nuisance and more of a pivotal, indispensable companion.

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