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Building Learning Technologies for Digital Humanities – A Review

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ABSTRACT

The ubiquitous nature of computing tools and the ready access to mobile devices such as smart phones and telecommunications networks coupled with the current trends in distance learning, are just a few of the reasons the popularity of using mobile devices for learning is on the increase. Population growth has brought an urgent need to improve the global educational development and coupled with present social factors that has created digital humans. It has become important to develop new teaching methods. Rashid and Rashid (2012) point out the acceptance of education as being "a key factor in economic development and social change". They also address some of the different approaches to education which have come up in recent years based on an increase in the quest for higher education plus the challenge of higher costs as being the precursor to distance education, a very viable and increasingly prevalent option. One could readily see how this alternative would greatly increase accessibility and enhance opportunities. They contend, and rightly so, that the influence of technology will actually help improve and establish a much-needed standard in distance education. This paper reviews the development of technology for education and elucidate important milestones in the progression towards the utilization of technology for developing educational artefacts for digital humans.

Keywords: Humans, ICTs, Educational technology, Artefacts, Mobile Systems, Androids, Learning.

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1. INTRODUCTION

Historically, ICT have entered the realm of education several decades ago. One of the most important concepts in education (e-learning) emerged in the late 80s. In the 90s when the power of desktop and handheld devices grew significantly and became more affordable and ubiquitous, e-learning became even more popular (Hashemi, Azizinezhad, Najafia and Nesari, 2011). Several writers through the years have made a case for the application of technology in education. From the experiments done by B F Skinner (Lever-Duffy and McDonald, 2011) on individualized learning and programmed instruction they postulated that technology will play a large role in instigating the changes in both our society in general and education in particular. The growth rate of this change has been astounding. Moore's Law claims that the power of computers doubles every 18 months and studies carried out on just how technology assists education gives vast opportunities for more research. Different studies have been carried out showing the importance of mobile learning technology. Oyo and Kalema (2014) explored the use of technology in their article on Massive Open Online Courses (MOOCs) in Africa for Africa.

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Journal of Behavioral Informatics
Digital Humanities & Development Research
Vol 4, No 4, December, 2018

They itemized the advantages of online courses for the developing countries in Africa, knowing full well that we suffer from a deplorable lack of infrastructure and that there is a need to actively redeem the time lost while the developed nations are constantly on the move forward. AlShareef (2018) also provided empirical evidence that there is a strong approval on the feasible uses of mobile learning and roles in supporting the teaching and learning of English at the secondary stage from the viewpoint of the supervisors and teachers of English in the city of Mecca. Vrana (2018) postulated that with the increased number of users of mobile devices, m-learning has established a solid basis for its implementation worldwide.

2. DEVELOPMENTS IN COMPUTER TECHNOLOGY AND EDUCATION

Computers have evolved in use from giant data processing machines to hand held "smart" handsets. Computer technology can be described as the hardware and software units that make up a computer system: hardware referring to the physical components, and software being the codes, programs and applications that make the system work. Because computers are digital electronic devices, and because the development of such devices is constantly evolving, computer technology undergoes regular, rapid changes, but the basics and the fundamentals remain the same. This basic thrust is that information (or raw data) is input to the system and more information (processed data) is output for use. Basically; **input + process = output** is the flow of all activities in a computer system.

In education, there are various ideologies that give room to the broad definition of learning. Generally, learning is said to take place when an idea or lesson is planted firmly to the extent that there is a change in behaviour. Lever-Duffy and McDonald (2011), in their book Teaching and Learning with Technology, give more details. They show that there are a number of psychological views and theories which explain how learning takes place. They also explain that there are different aspects to consider including the very essence of the communications process between a student and a teacher. The different perspectives that have in recent history given rise to the varied but integrated learning theories are important themes to consider when discussing teaching methods, such as the use of technology in education. The introduction of technology in education is giving rise to new fields of research. The scope of learning available as well as the numerous advantages is an ongoing discussion. This is why it is important to carry out studies on the use of mobile devices, in order to evaluate the trends in computer aided instruction and to promote the use of mobile instruction.

Kearney, Schuk, Burden, and Aubusson (2012) advocated that "portable, handheld devices have increasingly powerful multimedia, social networking, communication and geo - location (GPS) capabilities and consequently, mobile learning (m-learning) offers numerous opportunities as well as challenges in education". Lever-Duffy and McDonald (2011), also describe the different kinds of technologies available for both students and teachers. They go on to show the importance of wireless devices and the idea that physical restrictions are removed which means that "the teachable moment when students inquire and are ready to learn does not have to be postponed until wired connections are available". In describing the vast resources available on the Internet they say "... as the Internet and the World Wide Web have had a dramatic impact on society, so too they had an impact on education" (Lever-Duffy and McDonald, 2011). Indeed, there is great potential for mobile learning. Keskin and Metcalfe explored specifically the "potential to apply mobile technologies to enhance learning". The understanding that mobile learning hinges on the "portable, ubiquitous and easy accessibility" of mobile devices has caused a surge of growth in its popularity. They go on to describe mobile learning theories in a tabular form identifying the definition and focus of these theories with examples. They also explore some examples of mobile learning applications including their graphics to depict what these applications are used for, and to show the different implementation strategies and perspectives (Keskin and Metcalfe, 2011).

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Journal of Behavioral Informatics
Digital Humanities & Development Research
Vol 4, No 4, December, 2018

2.1 Applications of Computers in Education

In recent times, computer assisted instruction (CAI) has become one of the more popular methods of promoting learning styles, learning techniques and learning aid. Macaruso and Rodman (2008) discovered that Phonics-based CAI enhances early literacy skills in preschoolers and kindergartners. It has grown to become the favored means of carrying out lessons, and giving lectures. It has also been shown that CAI can be used in defining the clear goals and objectives for the outline of teaching. It covers a wide range of involvement and can refer to the use of computers to teach a particular course or to develop course content. It can be the provision of audio-video lecture delivery or presentation of the very items to be covered (e.g. power point presentation). It can mean using computers for learning or learning about computers. Computer assisted instruction is quite wide, and for the purpose of this study it will be narrowed to the development of course content and delivery via electronic means.

Historically, learning was by books and blackboards with the teacher explaining the lessons. Of recent, learning is often in the absence of the classroom walls, and computer technology has overtaken the teacher, the blackboard, the lesson scheme, and even the students' participation. Once upon a time there were only books, desks, blackboards and tables. Now there are keyboards and touch pads, interactive whiteboards and touch screens, overhead projectors, handhelds, e-books, mini laptops, wireless networks, mobile apps, and a plethora of computer hardware technology. And as such, "the world's knowledge base can be placed at the fingertips of every learner" (Lever-Duffy and McDonald, 2011).

2.2 Considerations for Computer Assisted Instruction in Education

Lever-Duffy, J. and McDonald, J .B. (2011), in their standard text - Teaching and Learning with Technology, explained in detail how computer assisted instruction evolved, and how it actually encourages both students and teachers. The former are enabled to learn more constructively and the latter are better able to apply more effort. Even students with special needs are mentioned and the opportunities that abound for technology solutions for them. CAI at its different levels holds much promise for both staff and student. Jacob and Issac (2008) describe different learning types and the ways in which mobile learning helps the students and even the faculty.

3. HISTORY OF MOBILE SMART DEVICES

Mobile devices are small handheld gadgets used for communication. The accepted birthday for the cellular telephone is April 3, 1973 (Jackson, 2018). Standing near a 900 MHz base station in midtown Manhattan, undoubtedly surrounded by bell bottom jeans and crocheted midi-dresses, Motorola employee Martin Cooper dialed the number of Bell Labs in New Jersey. We don't know exactly what was said on this call. We do know that Cooper used the Motorola DynaTAC 8000x, a product that wouldn't go on sale to the public for another decade. But that call was the beginning of a mobile revolution. By 1979, Nippon Telegraph and Telephone (NTT) introduced the first ever (analog) 1G phone service in Tokyo. 1980s – Although NTT gave Japanese consumers the first access to mobile phone service, it was several years before the technology moved into the mainstream worldwide. On October 13, 1983, Ameritech Mobile Communications became the first company to launch a 1G phone network in the US, starting with Chicago. On March 13, 1984, the Motorola DynaTAC 8000x of Cooper's call finally went on sale—for $3,995. The 8000x wasn't very mobile (it weighed almost two pounds and took ten hours to charge for thirty minutes of talk time). By April 25 1989, the Motorola MicroTAC 9800x showcased true mobility with its (relatively) compact size and flip-up mouthpiece. Of course, they both still had antennae, and could only be used to place calls.

1990s – Appropriately for a decade that saw the reunification of Germany and the official formation of the European Union, the first GSM call was made in 1991. The GSM standard established a common network across Europe and provided users with uninterrupted service even when they crossed borders. The first GSM phone, the Nokia 1011, which went on sale November 9, 1992, also introduced text-messaging. And here's where we preview the smartphone.

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Journal of Behavioral Informatics
Digital Humanities & Development Research
Vol 4, No 4, December, 2018

When IBM's Simon was released on August 16, 1994, it was a bit early to the game. You could send email (and faxes!), sketch on its touchscreen with the included stylus, and consult the calendar, world time clock, and address book. But you couldn't surf the web—after all, NCSA's Mosaic browser had only appeared one year earlier and home computers were just starting to adapt. 2000s – If the smartphone was born in the nineties, then it came of age with the millennium. NTT DoCoMo launched the first 3G network in Japan on October 1, 2001, making videoconferencing and large email attachments possible. But the true smartphone revolution didn't start until Macworld 2007, when Steve Jobs revealed the first iPhone. Previous phones relied on keypads and could only navigate a watered-down version of the internet. The iPhone's large touchscreen could flip through websites just like a desktop computer, all while looking sleeker than anything consumers had ever seen before. 2010s and beyond – So here we are in 2019 and worldwide use is expected to pass five billion by the end of the year. Mobile devices are used for so much more than calls: dating, job-hunting, reading books, and watching movies.

4. THE CONCEPT OF ELEARNING

E-learning is a broad term that describes the process of acquiring knowledge through some form of electronic means. It could be a formal, structured course made available online, or simply an informal process of learning some facts or improving understanding through electronic means, that is through information and communication technology (ICT). Basically E-learning is the form of learning "which is supported and delivered through the use of ICT" (Clarke, 2011). As it is, the inclusion of all kinds of educational technology makes this a very loose term. This means that eLearning covers computer-based instruction, computer assisted instruction, mobile learning (or m-Learning), online education, and a host of other synonymous learning styles. This also means that eLearning has various aspects of discovery, and delivery. E-learning is far more dynamic than traditional forms of instruction. The flexible options of time, venue, pace of study and fewer constraints make it appealing.

The available options of individual study, group study or collaboration also help students select learning styles that suit them, and not just the commitment thrust on them. These are some of the advantages. Other advantages include the opportunity to interact more, improvement through practicing using computers, continuing education (no age barrier) and over all a greater opportunity to receiving education. There are several disadvantages too. These include the fact that it is easier to falsify the extent to which one understands, by simply copying answers. It is often assumed that students who are knowledgeable in IT have an edge; this is not always the case. At times it is the teachers who lack IT knowledge and this leads to mismanagement of time, effort, and meaningful interaction. There is also the danger of failing to meet deadlines by simply putting off what needs to be done - procrastination. In addition a situation where students and teachers do not have visible audible direct contact can inhibit feedback.

4.1 The Use of Mobile Devices for E-learning

Mobile phones, tablets and I-pads are some of the more common mobile devices. They are readily available in different forms, sizes, and with different capacities. Over the years they have come to have expected standard functions, so much so that simple mobile phones now have cameras, radios, large storage and facilities to browse the Internet, chat in real-time, download e-books, and lots more. The capabilities of mobile devices continue to expand. This is what makes their use as learning devices very overwhelming. Whereas several decades ago a student had no choice but to physically attend classes in a fixed location, nowadays there are options to receive lectures (video/audio) on a mobile device, to save/store course materials on mobile devices, and even carry out assignments, without ever stepping into the classroom! The common acceptance of the "mobility" of mobile devices - be it the gadget or the individual who is on the move – this idea of mobile learning gives a whole new worldview to the concept of eLearning. Mobile devices have made it easier for students to have regular and frequent interaction with each other, as well as receive up-to-the-minute information from the teacher/lecturer/course administrator.

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Journal of Behavioral Informatics
Digital Humanities & Development Research
Vol 4, No 4, December, 2018

Opportunities to study entire courses abound, being able to receive so much while actively pursuing other interests has changed the way learning takes place. Many students own mobile phones, and the advent of smart phones further dramatically increases the options and materials available. Keskin and Metcalfe (2011) explain that MoLeNET in 2007 defined mobile learning as "the exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning". This succinct definition ends with the phrase that throws open so many doors for eLearning.

Adeboye, Daniel (2016) in an article showing the divergence of efficiency and effectiveness notes that while students are able to find ease of use in handling mobile devices and readily assert the efficiency of finding any and every kind of information whether general or course-related, there is the need to make mobile learning effective too. He writes "Students speak of the benefits of technology as making things easier, faster, better... easier communication, faster access to information, better and more comfortable studying etc. All these speak about doing work efficiently. But is this all technology should and can achieve? Shouldn't technology be helping students to be more effective in their work"? Certainly, a mobile app should be seen to be effective as well as efficient.

5. HISTORY OF ANDROID MOBILE OPERATING SYSTEM

Android debuted with an HTC made smartphone, the T-Mobile G1 in 2008 in the US. The phone was better known as HTC Dream outside the US and it was the world's first mobile device to run on the Linux based OS (Digit NewsDesk, 2018). It is an open source operating system primarily used in mobile devices. Written primarily in Java and based on the Linux operating system, it was initially developed by Android Inc. and was eventually purchased by Google in 2005. The Android operating system is symbolized by a green colored Android Robot logo (Techopedia, 2018). The development of the Android OS was a result of the consortium of the initial members of the Open Handset Alliance (OHA) such as Google, HTC, Dell, Intel, Motorola, Qualcomm, Texas Instruments, Samsung, LG, T-Mobile, Nvidia, and Wind River Systems in November of 2007. The OHA is a business alliance of hardware, software and telecom companies dedicated to advance the cause of open sourcing for mobile phones.

Based on the modified version of the Linux kernel version 2.6, the Android code was released by Google under the Apache license which is also a free software and open source license. The Android OS consists of numerous Java applications and Java core libraries running under the Java-based object oriented application framework and the Dalvik Virtual Machine (VM). Dalvik is integral for the Android to run in mobile devices as these systems are constrained in terms of processor speed and memory. As for multimedia support, the Android OS can back 2D and 3D graphics, common audio and video formats. It may also support multi-touch input (depending on device) and carries Google Chrome's V8 JavaScript runtime in its browser. Android's earlier releases were particularly for mobile phones, and some releases are for tablets only. In the student environment it is generally known and accepted that android phones are the most popular. Android phones are more versatile, have more options, usually have larger screens, and generally are more pocket-friendly than their Blackberry, iOS, Windows and Symbian counterparts. Table 2.1 shows the dominance of Android in global mobile OS shares (GlobalStats, 2018). For this reason Android was the preferred OS for the proposed app.

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Journal of Behavioral Informatics
Digital Humanities & Development Research
Vol 4, No 4, December, 2018

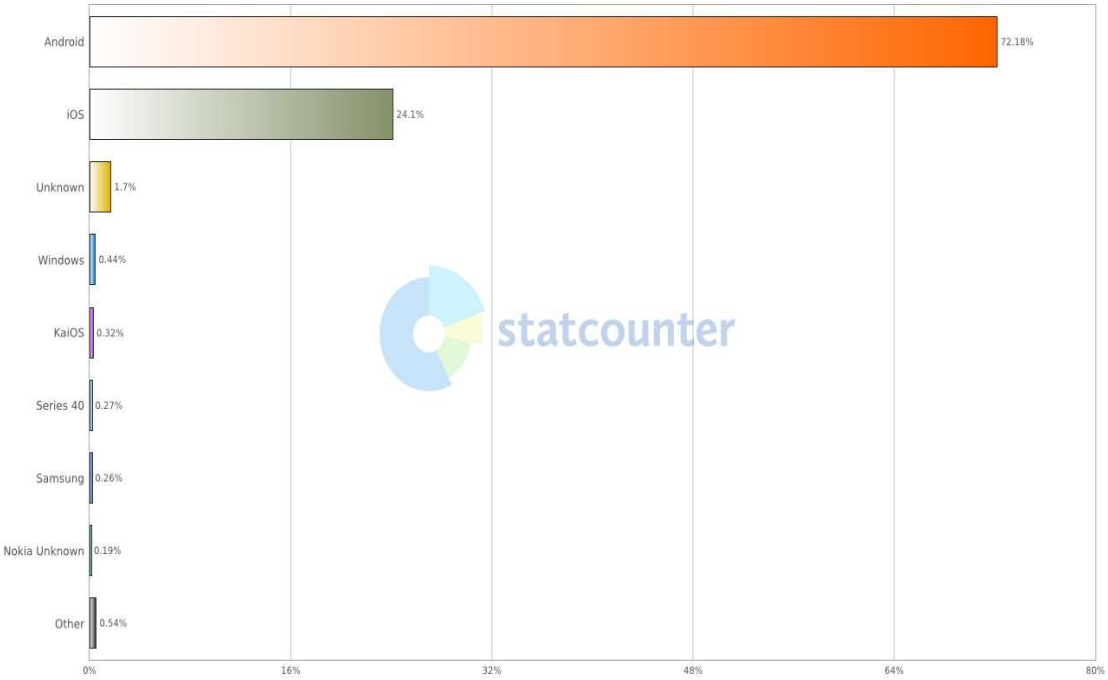

Fig. 1: Mobile & Tablet Operating Systems Usage in 2018

5.1 Offline-First Applications

Most practical apps are a gateway to the Internet, connecting users to social, media or informational sites. Most apps work best when they have a good Internet or WiFi connection. But when the app has a large directory of information – a supermarket shopping app or study app for example – poor connectivity can result in a user experience that's slow and frustrating. 'Offline-first' is a development approach that ensures an app will work as well offline as it does online. Creating an offline-first app can, in the right context, ensure a more reliable and faster experience, retaining users and providing a better user experience for your customer (Melamed, 2018).

Most apps are composed of software on a device and content on a server. To access the content, the device must talk to the server. The server is therefore the repository where all the storage, management, handling and updating of content happens. This remains true when multiple user-facing interfaces, like websites and apps, require access to a single database, and having all the content in only one place is much simpler than trying to coordinate and synchronize multiple places. As a result, most of us assume that shopping or directory apps – those providing access to large datasets – need to be online at all times, slowing down whenever there is a slow connection and not working at all when the user is offline. Not so. With forward-planning and user-first thinking, it's possible to offer a fast, high-quality app experience offline. And the benefits of doing so are considerable. The disadvantage of most online apps is that they need a decent and reliable internet connection. When you don't have one, the app is likely to be slower and less responsive or totally dis-functional. For this reason the app developed in this project work is designed to allow both off-line and online study of Msc Information Technology courseware.

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Journal of Behavioral Informatics
Digital Humanities & Development Research
Vol 4, No 4, December, 2018

5.2 Mobile Learning

Cochrane (2012) in an article on the failures of m-learning, highlights some of the results of his six-year research on the findings of projects aimed at encouraging students to use mobile devices for certain full-length courses. The paper – Secrets of M-learning Failures: Confronting Reality – focuses on three projects and the way they actually failed to achieve a greater benefit for the participating students, and their course instructors as well. The reasons he gave point to various factors being responsible for the failures of the projects. The interesting point is that there were less than ideal situations on the part of both instructors and students. It was not a one-sided affair. However, as Cochrane was able to infer from his studies, it is often the failures experienced that give rise to successful re-runs of similar projects. In addition major innovations developed from active research are from "failed" projects which themselves go unreported. Therefore the lessons learned even from mobile learning failures can and should result in better plans and better achievements.

A detailed study carried out in 2005 by O'Malley, Vavoula, Glew, Taylor et al. shows some of the differences in the perception of mobile learning including the burgeoning dimensions. They cite Quinn, Wood and Harris' definitions of mobile learning as "...eLearning through mobile computational devices: Palms, Windows CE machines even your digital cell phone" and "... the use of mobile and handheld IT devices such as PDAs, mobile phones, laptops and tablet PCs, in teaching and learning". They go on to wrap up the definitions by expounding one of their own – Mobile learning is "the learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies". By this they show that mobile learning is not only when the hand-held technologies like mobile phones, tablets, etc are being used to learn, but equally when a learner is on the move, i.e. mobile. In which case there are no technologies being used but the concept of being on the move is significant. They even illustrate this perception in a neat and easy to explain table (Table 2.1). (O'Malley, C. et al, 2005):

Table 1: When learning is mobile

Technology / Location	Fixed	Mobile
At usual environment (home office classroom)	Non-mobile learning	Mobile learning
Away from usual environment	Mobile learning	Mobile learning

It must be stated that mobile learning can affect so many courses of study, even non-technical ones. Kutluk and Gulmez (2013) carried out some research on students who took accounting lessons at a certain level in university to examine how mobile learning was beneficial (or otherwise). They retrieved data from a wide sample of students and conducted various statistical tests on the data to enable them see how mobile learning can be effective. Typically they highlighted the main advantages of portability, instant connectivity and context sensitivity However, they also showed that life-long learning and anytime anywhere learning is also beneficial. Disadvantages such as limited memory, small-screen size, network disconnection at times and limited battery life as well as issues of cost and familiarization of device usage by both students and faculty, were also listed.

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Journal of Behavioral Informatics
Digital Humanities & Development Research
Vol 4, No 4, December, 2018

5.3 Mobile E-books

Mobile learning devices have been found to be efficacious in the consumption of information with one of their most notable capabilities being their utility as e-readers. Students are choosing to buy e-books that they can easily download on their tablets, while professors are choosing to upload excerpts from texts as PDF files and sharing them with students (Geist, 2011). Kissinger (2012) in his study on the social and mobile learning experiences of students using mobile e-books examined how learning environments can adapt the use of e-books and e-book readers in replacing textbooks and whether the advent and increased use of technology is adding to the value of student experience and in promoting learning. With the increase of technology-based learning, colleges (and universities) across the U.S. were looking to explore the advantages not only of the e-book technology but also the increased option of mobility. Kissinger highlighted various theories of learning and how these played out in the application of mobile learning. For instance, he looked at constructivism which he said was broadly defined by the way students can individually create and maintain their own learning skills. Another theory he described as a fairly recent development was Information Processing Theory in which mobile devices, being portable, can aid the working memory.

Kissinger went on to cite others in explaining mobile learning as “the use of mobile, portable and hand-held computing devices in learning application and environments”. His research questions covered learning experiences of students using mobile e-books in online and classroom-based courses, exploring factors that enhanced or impeded the successful use of mobile e-books in studying and considered changes students desired in mobile e-books that would aid learning.

5.4 Mobile Distance Learning

As collegiate institutions begin to recognize the paradigm shift of mobile device use, redefining the way information is consumed, disseminated, and used, it is essential to conduct more studies in this area (Geist, 2011). In their article on the application of mobile learning to online distance education at the Norwegian Knowledge Institute (NKI), Rekkedal and Dye (2007) explain their findings in some detail. This programme was to enable mobile distance learners to have access to forum discussions, messages, and general communication with other students as they were on the move. The project recognized the fact that ordinarily distance learners would have access to the basic desktop or laptop connected to the Internet. However, for learners who are often on the move, the options of mobile devices would provide additional modes of study.

Students turn their mobile devices into learning tools through the use of mobile applications, or “apps”. In a research conducted by Foti and Mendez (2014) a majority of students reported the use of the Quizlet LLC “app” as a study tool. Quizlet LLC is a company that creates free study tools that can be accessed through their website or mobile apps. Through the use of Quizlet LLC, students are able to upload course content to create flashcard sets that can be shared and edited by their classmates. Other features include games and quizzes to help students learn exam material. In the article - Mobile Distance Learning with PDAs - Rekkedal and Dye explain the need for greater flexibility in distance education. They further expounded on why this was a philosophy of learning at NKI, the aim of which is to provide “qualitative changes... in students’ understanding, academic, social and technical competence”. This goal, which really should be carefully considered as an end to the means would broaden students’ viewpoints, and would take away from the prevalent methods of providing large amounts of facts which students on testing are encouraged to reproduce, often verbatim. This is, more often than not, a deterrent to true learning. It would therefore appear that the aim and philosophy at NKI should be widely repeated.

Teall and Wang (2011) in their article on the subject build a strong case for the importance of identifying current guidelines in m-learning, current frameworks in m-learning and how these are brought to bear in developing countries. This last point is particularly of interest considering the context of this study. The authors point out the obvious fact that m-learning is a means to provide education for areas of the world that are not easily accessible and not well developed. As remarked earlier, this seems a tall order until one considers the astonishing growth in numbers of mobile phones in such regions. Teall, Wang and Callaghan (2011) give examples of findings in Asia and Africa from other researchers and justify the benefits shown from certain pilot programs run in several Asian countries. They note that Valk, Rashid and Elder in 2010 showed from these pilot programs that "mobile phones increased access to education". They however could not measure the level of learning actually achieved. Of particular interest was the review they Teall et al did of studies in Africa where it was recognized that "a large and growing percent of the population has a mobile phone". M-learning is a very welcome and very viable option in Africa. It is with these findings that Teall et al progressively state their case in their literature of the need for M-learning guidelines and frameworks that will make clear the options and objectives of learner interaction irrespective of the different backgrounds learners are from.

6 CONCLUDING REMARKS

The literature surveyed revealed the endless possibilities of the use of mobile devices as a tool to distance learning. The necessity of such devices and the importance of promoting their use cannot be over-estimated. The micro contributions of research studies such as this one will also help fill the gap in the knowledge of options and applications available. There is a growing need to make ample use of the ubiquitous nature of mobile applications and devices. As such, one cannot over-emphasize the development of computer assisted instruction and M-learning. It is however necessary to realize that there are limitations to the application of computers and mobile devices to learning. There are still academic disciplines that require the traditional teacher and classroom setting.

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