

**PROMOTING THE USE OF MOBILE DEVICES FOR E-LEARNING SOLUTIONS:
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Abstract: *E-Learning is a broad and relatively novel concept that covers the use of electronic devices in delivering formal education. This research work aims to consider some of the diversities entailed and some of the specific ways that electronic devices can promote learning. Of particular interest is the use of mobile devices, considering the contemporary surge in smart phones and the roles these can play in individualized learning. The shift in possibilities as well as the seemingly endless options available are some of the concepts explored in this work. The android app developed is primarily to show the prospects of establishments such as National Open University of Nigeria (NOUN) which offer strictly open and distance learning that mobile devices can be used to promote learning. This will be shown to be innumerable and could easily validate many more studies in this field. The application (app) developed in this project was for an android device, which by far is the most common mobile operating system available presently. The procedure involved the use of android studio which provides an environment for coding and testing apps on an android phone. The widespread preference as well as the ubiquitous occurrence of android based smart phones was the factor behind this platform choice.*

Key words: *Android app, Computer-based learning, Development, e-learning, Mobile devices, Open and distance learning*

1. INTRODUCTION

Formal education is key to a nation's development. This is a generally well-accepted premise. Many countries that have advanced economically, technologically and in areas that show real promise and hope for future generations have been countries that paid close attention to formal education. Studies show that education is a means to progress and a means to improving a society and a country as a whole (Siddikhi, 2012; Federal Republic of Nigeria, 2004). Education has been one of the ways a society develops itself, improves itself, and prepares the next generation for leadership and progress. Simply put, education "plays [a] vital role in national development" (Rashid and Rashid, 2012). A well-developed educational system is directly related to a country's improvement and advancement in so many areas. It is therefore important to study the systems of learning and examine on a regular basis how helpful they are. It is also essential to occasionally review the current status and look for ways to improve. With the current explosion in information technology, and the relationship with educational systems, it is necessary to explore the many options available for the interaction between education and information technology.

In recent times, the application of technology in virtually every human endeavor is becoming more and more significant and to some extent indispensable for relevance in developmental programmes. Industries make use of computerized equipment for quality control and efficiency among others. Isman, Baytekin, Balkan, Herzum, and Kiyici (2002) suggested that the use of technology in education will provide students with a more suitable environment to learn, will serve to create interest and a learning-centered atmosphere and will help increase students' motivation. Using technological equipment in order to aid learning has started becoming a common method in the educational sector around the world, including Nigeria.

Computer-based learning has appeared in many distinct forms since the early 1960s. Some of the more well-known forms include computer assisted learning (CAL) techniques, Computer Assisted Instruction (CAI) and Computer-Based Training (CBT). These have all shown that the interaction between education and technology is not only important, but it is also progressive. The broad all-inclusive term eLearning (or E-learning) covers the general idea of computer-based learning methods. E-learning refers to the use of electronic media and information and communication technologies (ICT) in learning and teaching. At National Open University of Nigeria - NOUN - where the open and distance learning method is used, nearly all the aspects of eLearning are exhibited including the fact that learning can take place at great distances and students and "tutors" may never meet, and tests are conducted "on-line". This trend is widely practiced in many countries and has made higher education more readily accessible for more people from various backgrounds. Ongoing research, however, shows that there is still a need to measure the actual effects and benefits of eLearning when compared to the traditional methods of teaching (Cochrane, 2012). Studies show that technology-based learning yields greater efficiency and helps students to be more focused. This explains why students with access to online forums tend to be better informed and better prepared to tackle the coursework required in Open and Distant Learning methods. Hence, there is need to integrate technology-based learning such as the use of mobile devices into all aspects of education.

Mobile applications for educational use as an extension of e-learning incorporates Computer Based Collaborative Learning (CBCL) which is one of the newer forms of e-learning undergoing much research. This branch of eLearning would greatly increase the drive and advancement of computer based learning particularly for higher education, in part because collaborative learning promotes accountability and interdependence and it also aids different learning methods. When considering the National Open University and the level of learning and studying required, particularly the self-paced study style, it seems important to weigh carefully the benefits of computer supported collaborative learning. In an age when most learning and development at post-secondary level is very individualistic, being able to share knowledge and develop such knowledge will encourage team-spirit and foster collective development. The self-study system, by its very nature promotes an individualistic learning style.

This is an inspiring idea for a mobile application (app) for National Open University of Nigeria (NOUN) students. The materials for all the courses are available online for download, and hard copies are also supplied when students register (as long as they are available). Students are generally encouraged to study hard, attend tutorials where possible, form discussion groups, complete their Tutor-Marked Assessments (TMAs) and prepare for exams. Ideally, students need to be able to go beyond studying just to have a grasp of the course content, and then reviewing TMAs and past question papers where available when revising for exams (as is often the case). Students need to be able to have the kind of interaction that promotes learning even though they are undergoing an Open and Distance Learning programme. This way, students are not just studying to pass exams but they are actually acquiring a knowledge-base that improves scholarship. Since most students of NOUN are part-time students, (civil servants, business owners, or employees who make good NOUN's motto *Work and Learn*) finding ways to utilize the precious hours of study can be a hurdle. Hence, the need to form collaborative networks in addition to the facilities provided by NOUN Centre's is important. For those with regular online Internet access, the task is made easier. However, with the increasing number of students owning smart phones then it becomes worthwhile to explore options for interactive

forums. It is very advantageous to use such options in promoting the use of mobile phone devices for e-learning solutions for NOUN students. The app developed in this case, however gives an initial stage to the thought by providing access on the phone to materials made available online by NOUN for Masters Students in Information technology. This way students can have really mobile access to course material.

1.1 Aim and Objectives of the Study

The aim of this study is to promote online learning through the use of an android app. The app will make access to course material very easy and handy. The research work aims at achieving the following specific objectives:

- a) Develop an android application package to encourage mobile learning;
- b) Provide access to course materials and other links through the use of the android app;
and
- c) Promote the use of mobile devices for study and collaborative learning among students.

2. LITERATURE REVIEW

Several writers through the years have made a case for the application of technology in education. From the early years of the 20th Century and the experiments done by B F Skinner (Lever-Duffy and McDonald, 2011) on individualized learning and programmed instruction to the current proclamation of the advancing fourth industrial revolution and the place of education in preparing us as well as upholding us, the growth of this movement has been astounding. Studies carried out on just how technology assisted education gives vast opportunity for more research.

Historically, research has shown the importance of new teaching methods that improve the learning process. Presently there are various contemporary options being developed and pursued. Computer technology is one of the vast areas that is being explored. The ubiquitous nature of computers, the current trends in distance learning, the mobile access via smart phones and telecommunications networks are just a few of the reasons the popularity of mobile devices for learning are on the increase. Expansion of population bringing on the urgent need to improve the nation's development coupled with the influence of social factors are all important reasons why new teaching methods are desirable. Mobile devices would readily provide a bridge to the desired point. Rashid and Rashid (2012) in their article on the Issues and Problems in Distance Education - point out the acceptance of education as being "a key factor in economic development and social change". The authors 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.

There are different researches that have been carried out showing the importance of mobile learning technology (Markiewicz, 2006; Wang, 2006). Oyo and Kalema (2014) explore the use of technology in their article on Massive Open Online Courses (MOOCs) in Africa for Africa. They itemize the advantages of online courses for the developing countries in Africa, knowing full well that we suffer from a deplorable lack of infrastructure and there is a need to actively redeem the time lost while the developed nations are constantly on the move forward.

3. METHODOLOGY

This research study on promoting the use of mobile devices for eLearning solutions seeks to make use of existing platforms to further the practical advantage of learning in an open environment. The previous chapters have already explained the "whys" of the proceeding, especially with regard to growth and development in the learning process. It is important to note that the general idea of this project is far from novel. There are already various applications made available online and on mobile platforms to encourage learning. This study aims to develop the already existing interest and then provide a means to utilize that interest. It should also be noted that at the time of the proposed research such an application for NOUN was not available. In the ensuing months, however, the NOUN *iLearn* portal has been launched which to a large extent covers the subtitle of this project. It seemed necessary then, to understudy the existing NOUN *iLearn* application, which is actually a full web-based application, with the hope that some possible variations could become usable options. This chapter therefore seeks to develop such a variation, still with the aim of advocating the many opportunities available for mobile devices as learning platforms.

Considering the many efforts by producers of learning systems to provide online courses as well as materials and other learning aids, it bears re-stating that mobile learning systems are one of the main ways to promote individual learning as well as learning on the move. Mobile learning systems are means to enlighten a largely mobile group of individuals as well as encourage judicious use of time. Many students of distance learning programs can snatch a few minutes every now and then to revise materials, to review test questions, to read up on topics for assignments. All these can be done while on the move. A little here, a little there and the brain keeps (actively) taking in what is given.

In recent times, digital learning has become the rave and as such, conventional classrooms must also look for ways to digitize work content. Such was the goal of the Norwegian Knowledge Institute Distance Education program (Rekkedal and Dye, 2007). Projects to promote mobile learning using Personal Digital Assistants (PDAs) were carried out. The learning materials were made available as material that could be downloaded and studied offline as well as having online access to discussion forums and other interaction with teachers and students via email. For the most part, according to Rekkedal and Dye, students were able to make good use of the course content once delivered to their mobile devices. However in the case of typing up assignments etc., they were fitted keyboards to enable them carry out such functions more easily. It was important to find solutions that fit mobile learners.

Equally, there is the argument that digital learning needs to be effective as well as efficient. Adeboye, (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?" (Adeboye, 2016). Certainly, a mobile app should be seen to be effective as well as efficient.

Invariably, as all challenges go, there is a solution. There are ways to review the online portal, and the options offered, as well as student responses, and the usefulness of the site to actually promoting learning. The current 2015 NOUN *iLearn* Beta is a unique expression of an online learning system which comprises individual student profile, access to facilitators, question and

answer forum, friend connections, resource materials and other needful appendages. This platform was very well received when it was launched mid-2014, about the time this study was also being undertaken. This led to an adjustment on the app to be developed for this project. In a sense it was better to have the NOUN *iLearn* in place as this afforded a means to study the existing package. It was also seen to be advantageous because it helped to present a learning experience that was very practical.

Android mobile operating system was launched in 2008 by Google Inc., and has grown astronomically in acceptance and use. It is mostly free and open-source. However, the apps developed and available on Google Apps' *Playstore* are proprietary. 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. A simple survey showed that 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. This universality is what keeps the choice simple.

3.1 Application Design.

As the main thrust was basically to promote the use of a mobile application for learning, having a straightforward plan seemed to be the choice of the day. For all these reasons and more a simple design for the app was outlined as shown in figure 1

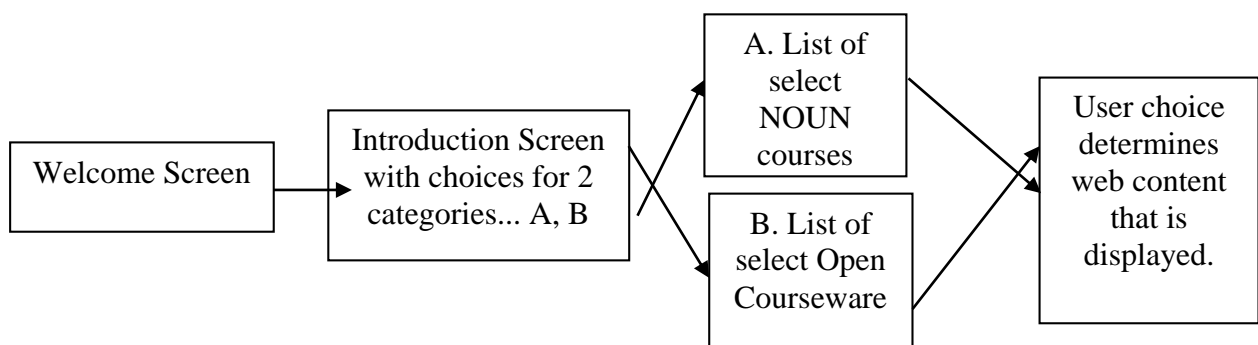


Figure 1 Basic Application Design

At the start of the app, these would be a basic welcome screen, followed by an introduction screen which would present the user with choices. The selected choice would then determine which list of courses is made available to the user from which any option selected would further lead to a fourth screen displaying the course content or more options.

3.2 Application Development.

Mobile application development requires quite some background knowledge that differs significantly from regular web application development. In the course of researching the necessary tools for developing the application for NOUN, it was obvious that certain languages will have to be learned or re-learned. Ordinarily mobile applications running on android devices are developed using Java and/or a combination of other languages and platforms: *ruby*, *python*, and *django*. Sometimes the interfacing between these different platforms can be quite complex. One graphic attempt to describe the links and interfacing needed for mobile apps is given on the following page (Brady, 2012).

Brady's map attempts to display in simple form the interfacing and interconnection between mobile service providers on one end and the major mobile phone companies (devices)

on the other end with the links between. This map helps to reduce the complexity often encountered in being able to show why a certain platform is preferred or used. The difficulty mobile developer's face is the choice(s) to make when one considers the different options each mobile operating system displays. There are different tools and environments on which to develop apps, and applications for one operating system may not work on another.

For the general android application, Java is the language in which its native code is written. This is the best option for android devices, because it enables full use of the built-in functions the device has, for example the camera. However, apps developed on this platform will not run on any other mobile operating system. One could develop a web application for mobile devices using HTML, CSS and JavaScript. Such applications would not be too different from websites, and would require constant re-direction to a browser link in order for the user to have access. Another disadvantage is that the app would not be able to launch with its own specific app icon. In addition it would not be able to use the device features like camera, and the user interface would not look like an app. (Brady, 2012).

The third option which for this project looked most promising was to use a development platform which "wraps the app in native code". There are several of these including PhoneGap, Trigger I O, Appcelerator, Sencha. These "hybrid" platforms make it possible to build an app that can make use of the mobile device's built-in functions such as the camera, have an app icon, and function like a true app without appearing to be a web application.

For the purpose of this project some interesting sites were visited and products reviewed. In order to develop the app for this project, it was apparent that the use of familiar languages would be more tolerable. However since the popular scripting languages would not on their own create a native app, it was necessary to use a platform that made web applications more "native". The platform selected initially was PhoneGap. PhoneGap is a fairly recent software development framework which even makes it possible to develop apps for all the popular mobile platforms listed in the table shown earlier: i.e., iOS (IPad/phone) Android, Blackberry and Windows Mobile OS. To use PhoneGap, the developer needs to be familiar with the scripting languages HTML, CSS and JavaScript. What Phone Gap does, is to take the web application developed using these languages and wrap it in native code. In this case, PhoneGap could really take care of some of the problems often encountered with restrictive choices. PhoneGap is open source and free. It can even be used to create apps for all the major mobile operating systems: iOS Blackberry, Windows, in addition to Android.

4. RESULTS AND DISCUSSION

Interestingly the modus operandi for PhoneGap was far more complex than a simple platform in which to develop an app. Not only was it necessary to download several different Integrated Development Environments (IDE's) and Software Development Kits (SDKs) in an attempt to find a viable option that would cover both current and slightly older versions of Android operating system, it proved difficult and rather cumbersome task to even analyze which of the options were necessary, and which were obsolete.

4.1 An Android Project

Android Studio was used to develop the app for this project. Android Studio is freely available on the Google Android Developer website. Android Studio is a very large program, approximately 2GB (Android Studio, 2017) and therefore requires a fast internet connection to download. It also needs to be updated on different fronts, particularly the Android SDK tools. This process was long and full of drawbacks. It is important for any beginner-developer to have

a steady course of tries as well as a project goal. The Beginner's Android App Development videos from Udacity by Google were very, very helpful. The android developer website has a series of guides and references and documentations and even a training manual (android.com/documentation, 2017). All this is very advantageous but at first rather overwhelming. Slowly it became clear that there are basic steps, as with learning any new concept or language. Other tools needed were the Java development Kit (JDK). This was available as open source on the Oracle website. Downloading this also proved to a task. There are different versions to consider as well as the fact that the JDK is a superset of the JRE, and as such they are not the same thing. Careful readership will help to put many of the glitches to rest.

In creating an android project, which contains all the files needed for the android app, it is useful to follow the guidelines on the android developer website (<http://developer.android.com/training/basics/firstapp/creating-projects>). This was a detailed outline of the process to be followed whenever an android project is setup. The project being the name given to the whole application - all the files and folders required for it to run successfully. However it was the Udacity Google videos that helped to clarify the process. (Google Developers Offline Kit, 2015). Several months of intermittent course training via Udacity and practicing with code from Github enabled the NOUN app project to become a reality at last. The process was long and the actual procedure was fraught with several delays as there was a consistent need to review, research and re-edit lines of code. In addition there was a lengthy learning process which ran concurrent with the app development. Even with the widespread use and acceptance of android devices, there is also the recommendation (android: developers, 2017) that apps are developed to target a wide range of devices. This is because the android operating system itself is continually being updated and devices that started with one version can be updated every now and then.

The actual application project was done with the help of the Google/Udacity Beginners' Course for Developing Apps. This began with the acquisition of Android Studio and some other add-ons. Android Studio is the software suite developed by Google (androidstudio.com) to make a platform available for developers. With the global increase in smart phones and the constant development of apps for users, it was only a matter of time before a more robust platform that would cut across mobile devices regardless of the manufacturer would be developed. These are devices running the android mobile operating system. Preliminary studies was done using the Udacity Beginners' Course (www.udacity.com) which consisted of a set of training videos with very rich instructional material and enough hands-on experience including practice sets. It was a lengthy process beginning with the downloading of tools to be used - Android Studio and the Java SDK toolkit. Much time was spent going stage by stage to download and disassemble the required tools because this researcher had not done any previous work on android app development. Mobile apps can be very basic, with just a few functional screens, and minimal input from the user. They can also be very complex, obviously. The need to make available a useful and easily downloadable app is one of the reasons why this app was kept simple. The mobile app (application) developed in this project is a fairly straightforward one. It had two preliminary screens starting with a simple welcome page as shown in figure 2.

On acceptance as shown in figure 3, a second (introductory) screen showing the user name input in the first screen and two main options are presented. At this point, the user selects the option indicating which category of study material he or she desires.

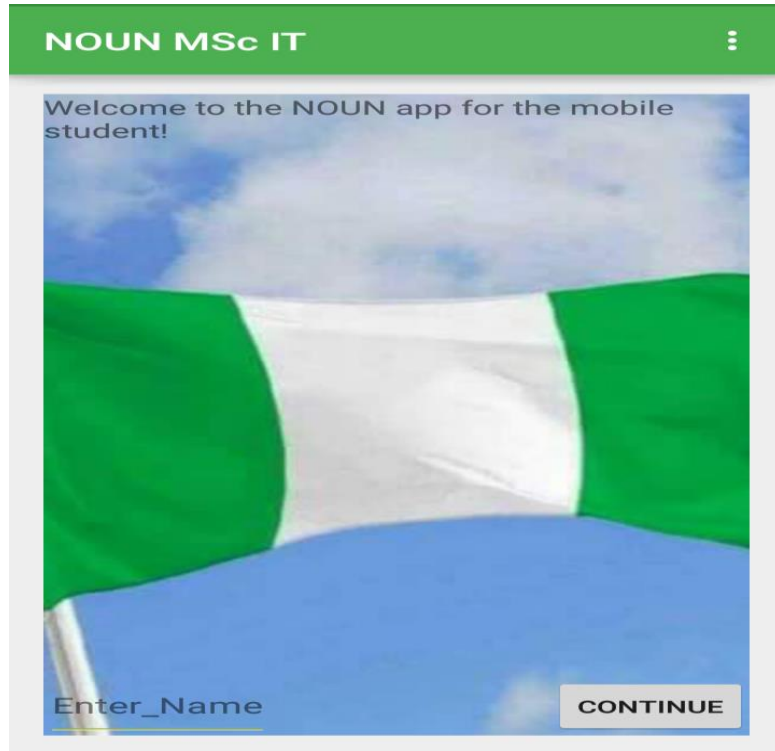


Figure 2: Welcome page

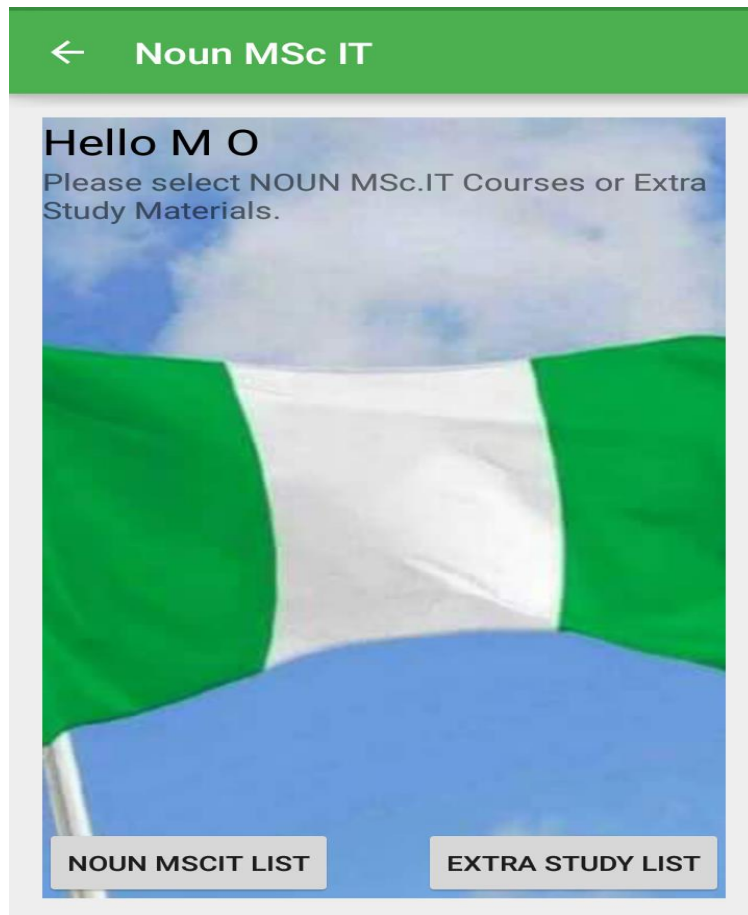


Figure 3: Acceptance screen

The option selected takes the user to a page listing the courses available for study. Each list item is a link to the actual course content. All the NOUN study materials are taken from the NOUN website. They are not stored on the user's phone except he or she chooses to download them for offline studying. This way the user can have notes available on the spot. This is key, and actually is the whole idea behind providing a mobile app that encourages learning while on the move.

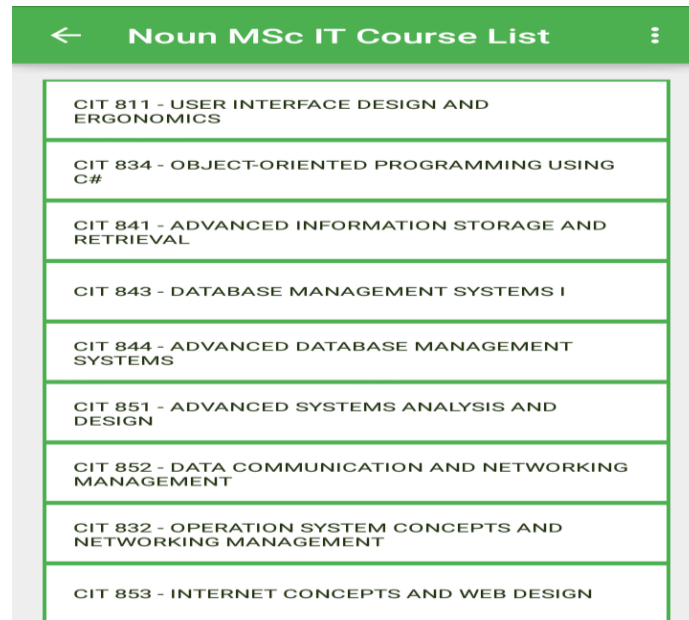


Figure 4: NOUN MSc IT Courses List Screen

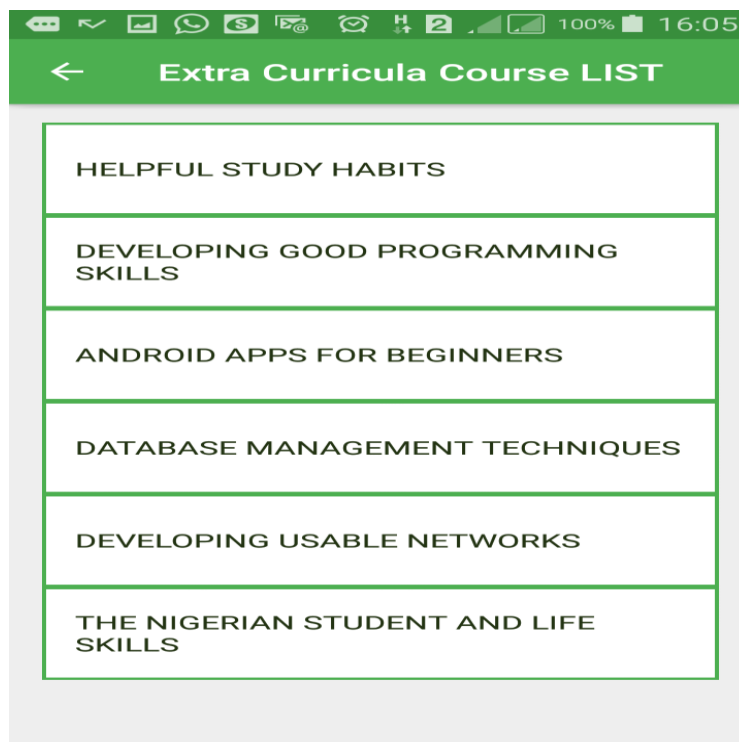


Figure 5 Extra Study List Screen

This appears in the pdf format and is easily available anywhere there is Internet access. It does not however save the file contents to the user's device except if desired. Each selection in the

page opens a new page, and the back button at the top of the screen will revert to the previous screen. The same style options are available from the Extra Study List. The second option (Developing Good Programming Skills) gives the page shown in Figure 7. In each screen scrolling to the bottom of the page will then reveal the link to the corresponding webpage. Selecting any option in the NOUN Courses List as shown in figure 4 will take the user to a new page with a brief snippet of the course and at the bottom of the page a link to the course material provided by NOUN on their website (www.noun.edu.net/courseware) (See Figure 5 and 6).

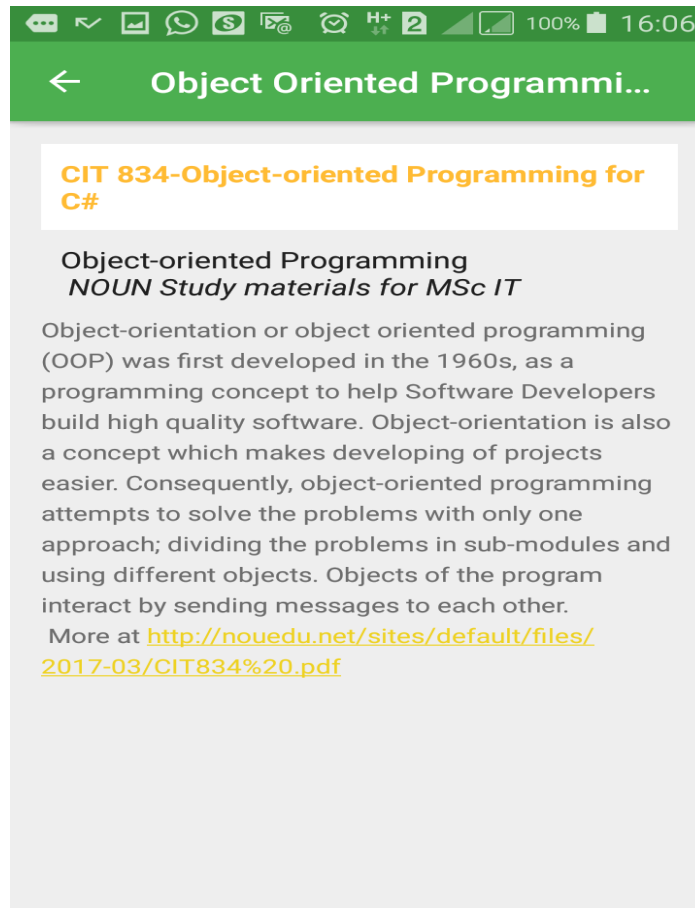


Figure 6: Object-Oriented Programming Using C# Screen

It should be pointed out that the name given by the user as input is merely used to welcome the student; it is not stored by the app and it has no bearing whatsoever on details given by the student for the NOUN website. Indeed, there is no password, as the app and the NOUN learning content tied to are not restricted in their use. All course materials for NOUN courses are freely available on the Internet (www.nouedu.net/). In order to avoid this confusion it is would be necessary to have a warning label indicating same. This is just to keep the views personal. The app would not allow editing of the study materials, just viewing and referencing. A more elaborate construction would require something similar to a forum or bulletin board type screen, where users can post their observations, questions etc. This is already available on the NOUN iLearn platform. It is enough that the user is able to access the material for studying and also make brief notes and share ideas. This is one of the aims of mobile learning. Considering that it is not very easy to type in notes even on a touch screen, it is likely that users may want to have access to reading material and a few pointers, but not very long sessions of using the phone's keyboard.

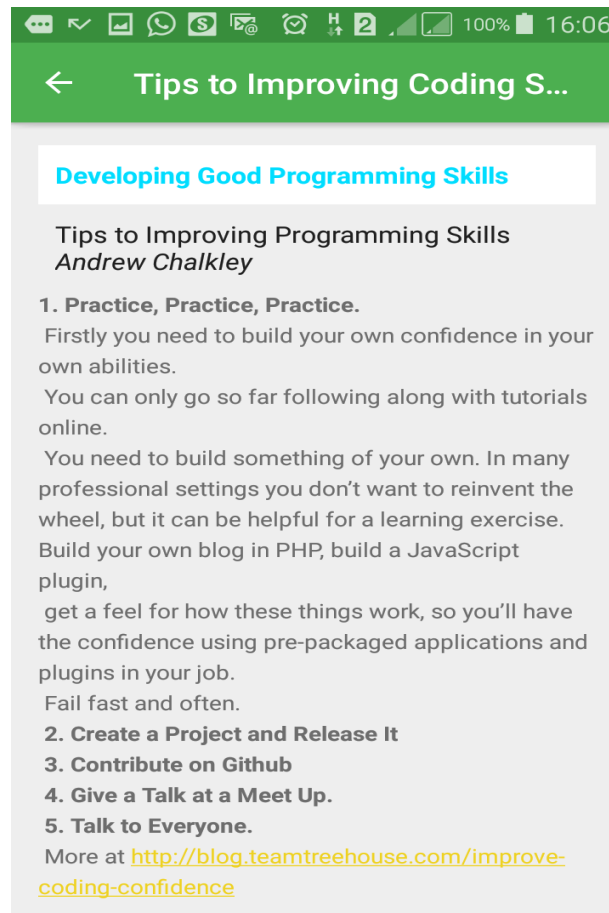


Figure 7 Developing Good Programming Skills Screen

This simple design would launch a mobile app for NOUN students and generally create awareness of the possibilities of mobile learning. When considering all that would be required in downloading material, the advantage of the app is that once material is downloaded it is then easily retrievable from the mobile device.

4.2 Discussion

The Android app developed was basically to make online course content available to Master of Information Technology students in the Faculty of Science. This was developed as an app and not just for individual to search and save. The app was not a complicated project as such; it was just a basic. The available resources made it a long drawn out exercise because of the preliminary study that had to be done in order to actually understand the different components involved in developing an app. The complexities encountered and the effects of having to cover significant ground in the development of the app also contributed to the time taken.

The Android Studio IDE had a code editor, IntelliJ that facilitated the process and provided an enabling environment for anyone just starting out in the learning curve of android app development. It adequately provides straightforward help through auto completion and colored markings etc. Learning through the online courses provided by Udacity and Google made the situation less complicated. Clearly the results of this app would require some measure of use and the feedback from users would be able to give ample assurance that mobile learning is a definite advantage to users who already have access to mobile phones and who are either

currently enrolled or approaching the point of enrollment and wanting to take advantage of the downtime they may have in their busy schedules. The outcome of this development is in line with the results of others researchers that carried out similar studies on the use of mobile devices for e-learning.

In Norwegian University of Technology, Markiewicz, (2006) developed a system running on Windows Mobile with content aware capabilities of foreign language learning system PALLAS (foreign language training system for Mobile real situations redetect put markets), used to support traditional classroom foreign language teaching. In Central China Normal University, Wang (2007) also designed a system running on the Symbian mobile English learning system, and realized the word memory, English articles etc. function module. In 2006 Wang of East China Normal University designed a run on Windows Mobile system on Mobile learning framework, and realized the coursework, and outdoor assignments and Mobile blogs function (Wang, 2006). Experimental and applied research from the above according to Di, Wang and Zhang (2012) revealed that the emergence of Smartphones, provides developers with a very malleable terminal platform and also the realization of domestic and international mobile learning technology applications and research focus and future direction.

5. CONCLUSION

Mobile devices are a great aid to the learning process. They are handheld, and therefore easy to move around with (mobile). They have incredible resources available and more are being developed daily. There are a host of apps in the pool waiting to be used. In this country, we need to greatly encourage the use of this technology. Only then can we truly move forward and develop. Much has been written about this. And so much more could still be done. We need to seek opportunities and take them, not just wait for other nations to pass them to us. There are means available even for students at secondary school to develop apps for learning, as opposed to making use of the social media apps that are so popular (which were also built by individuals). In addition, our education system clearly needs an overhaul that technology can readily and quickly help advance. Timely use of mobile devices to promote learning cannot be overemphasized.

There are pools of resources that students can take their advantages. Yes, the economy may not be encouraging, and the technology is still largely imported, and the infrastructure greatly needs improvement, but we can use what we have to go forward and make a way for our own progress and development. Through developing apps, students can learn not only how to make use of the learning opportunities, but the apps also make it possible to learn anywhere anytime once the mobile device is up and running. Clearly the learning curve is not easy but the means to tackle the difficulties are readily available. The millions of android devices in this country alone make for a compelling case no matter the course of study. For distance learning, and even eLearning, mobile devices are the wave of tomorrow starting today.

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