DEVELOPMENT OF MOBILE LEARNING APP FOR SELECTED TOPICS IN USE OF LIBRARY IN GENERAL STUDIES FOR UNDERGRADUATES IN NIGERIAN UNIVERSITIES

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Abstract
Mobile learning is creating a new paradigm for engaging the digital natives' students, with a flexible method of disseminating instructional contents. In fact, mobile learning is transforming the classroom all over the world, into a more ubiquitous environment where a learner can access instructional content at anytime, anywhere and anyhow. General Studies (GNS) according to the Nigerian Universities regulatory body (NUC) has been flagged as a compulsory course, which an undergraduate must pass before being allowed to graduate. The course was designed to help undergraduates fit well into the society and prepare them with soft skills for the world of work. However, the dissemination of the course has been marred with diverse challenges, such as overcrowding classroom, and others, thus making the students to dislike the course and perform below their expected capabilities. This research work was therefore embarked upon to develop a mobile learning application for the purpose of teaching a selected concept in the GNS series-Use of Library. The research deployed the use of the generic instructional development model known as the ADDIE. Each of the stages of the ADDIE model was religiously employed towards the development of the mobile App. Among other findings, it was discovered that the developmental process of mobile learning app is complex and cumbersome. More so, it was suggested that Nigerian Institutions can embark on the production of mobile learning applications for their courses, as this will assist in creating apps that are of indigenous curriculum-based content.

Keywords: Mobile Learning, ISD, GNS, ADDIE, Design and Development

Introduction

The 21st century advancement of technology and computing is ushering in an era of mobility, an era whereby users can have easy access to computing anywhere, anytime via the use of smaller and more powerful portable devices, expanding coverage for wireless and cellular networks, and a flourishing pool of applications that take advantage of these technologies promise that one day, most things you can do at a desktop computer will be possible from a mobile device (EDUCAUSE, 2010). Information Communication Technology (ICT) is becoming continually evolving with sporadic influence on all endeavor of human life. Every field of work has been, in one way or the other, influenced by ICT in the recent time. The fields of medicine, geology, law, even politics are now enjoying a great impact of ICT which has improve productivity. Education as a field and as an institution is not left behind in the technological 'explosion'. In fact, it is no longer a gainsaying that ICT and Education are becoming a 'Siamese' duo. Rapid development in one has led to a proportionate development in the other and it has in no little way better the later in great measure.

Moreover, the innovative development in mobile technological devices and the internet has seamlessly guided mobile learning into our educational structure and becoming a nascent part of the school system (Khanghah & Halili, 2015). Schools can now bridge the gap between the classroom and the society, as teaching and learning in various educational classrooms around the world are progressively keeping pace

with the benefits mobile device brings to the education system (El-Abbouri, Hildebrandt, & Puckett, 2014). Mobile devices are made in a wide array of sizes, designs, capabilities and functionalities, using the cellular networks and Wi-Fi or a combination of the two, they also possess touch-screen for easy user interface display. They run on diverse Operating Systems (OS), and support for software built on Java and Flash (Livingston, 2004; EDUCAUSE, 2010). It is no surprise however, how the mobile technology is the fastest spreading technology of the 21st century, making a population of over six billion subscribers worldwide (Regalado, 2013). To back this up, UNESCO (2015), asserted that for everyone person who accesses the internet from a computer two do so from a mobile device.

The use of wireless mobile device as suggested by (Chen, Seihamer, Bennett, & Bauer, 2015) will enable new learning opportunities, as its flexibility allows anyone to access information from anywhere and at any time. Ally (2009) is of the opinion that the use of mobile technology will allow citizen of the world to access learning materials and information from anywhere and at any time. The anytime and anywhere learning is referred to as Mobile Learning. Mobile learning, sometimes referred to as M-Learning, can be defined as any form of learning delivered through mobile devices. M-learning is learning delivered or supported by handheld and mobile technologies which guarantees learning anywhere and anytime (Laouris & Eteokleous, n.d.; Robinson & Reinhart, 2014; Traxler, 2007; United Nations Educational, Scientific and Cultural Organization, UNESCO, 2013). The term mobile learning translates to any form of learning that transpires when the learner does not settle at a fixed, predetermined location. It is a form of learning that ensues when the learner key into learning opportunities offered by mobile technologies such as mobile phones and handheld computers to enhance the learning process (Chanchary & Islam, 2011). Mobile learning involves change, it provides opportunity to effect changes in the tutors and peers' ability to communicate, as well as methods of accessing learning resources (Jisc, 2015). The mobile era is bringing new dimensions into teaching and learning, as opposed by the ancient didactic method, where the teacher assumes the role of know all in the classroom. Mobile learning is however creating a new platform, changing the orientation that learning is restricted in the classroom and considering mobility in learning which has promoted the proliferation of several application (App) adapted for mobile devices.

The Development of mobile learning App is a cumbersome process that requires adequate skills in software programming, graphics design, instructional design, and content localizing (Khanghah & Halili, 2015). Thes~~e~~ skills, if well harnessed can go a long way in determining the quality of the mobile App. Mobile learning App development should be useable, applicable and function-able in order to make learning to be fun, engaging and pleasurable to learners (Ching, Shuler, Lewis, & Levine, 2009; Marty, et al., 2013). Ten research priorities have been itemized to guide researchers in mobile learning development by Hsu, Ching and Snelson (2014) which are teaching and learning strategies; affordances; theory; settings of learning; evaluation/assessment; learners; mobile technologies and interface design; context awareness and augmented reality; infrastructure and management; and country and digital divide. These items create a window of opportunity for intending researcher in the area of mobile App development through selected learning content.

General Studies programme, being one of the important courses taken by undergraduates in all universities across the world, equip the students with diverse range of study and skills that are useful for the students' development by providing opportunity to grow, learn, and achieve priorities while in the university and after graduation (Northeastern University, 2009; Study.com, n.d.). The General Studies offer content that is aimed at stimulating and broadening student's awareness and knowledge in relevant fields outside the immediate area of specialization (University of Calabar, 2011). According to Ogenyi (2015), Nigerian universities can only meet the recommendations of Phelps-Stokes Commission on African education only if courses in the general studies programmes are well taught. This made the National University Commission (NUC) to approve the Basic Minimum Academic Standard (BMAS) in General Studies (GNS) for all Nigerian Universities in 1989 and thus making it compulsory for all categories of studies (Federal University Ndufu-Alike Ikwo, FUNNAI, n. d.).

The GNS programme has been instrumental to broadening the scope of reasoning and body of knowledge of the young graduates (Ogenyi, 2015). The compulsory status of GNS as a course led to overcrowded classroom, thereby making it unenticing for the students to attend (Nweke & Nwoye, 2016).

More so, students often complained on the manner to which the course is presented, a voluminous textbook full of theories and "stories" (Ihenetu, 2015). In order to salvage the depreciating situation of the teaching and learning of GNS in Nigerian Universities, it is imperative that educators should begin to integrate ICT in order to influence the teaching of the subject. It is no mere gainsaying that ICT motivates learners into active learning (Passey, Rogers, Machell, & McHugh, 2004), therefore, the capabilities of mobile devices as a resource for technological-enhanced learning can be deployed in order to improve the teaching and learning of GNS in the university.

Therefore, the proliferation of smart digital devices in Nigeria is on the increase and the country is projected to have 18million new smartphone users in 2017, and by 2019 the number of smartphone users in Nigeria would have grown to about 23.3 million new users (Statista, 2017). Millwardbrown (2014) reported that Nigerian spend most time using smart devices (smartphone and tablets inclusive), than they spend watching television and using laptops. Statistically, over 193 minutes is spent by Nigerian using smart devices, while television and laptop takes 131minutes and 80minutes respectively (Millwardbrown, 2014). More so, institutions around the country have been playing diverse roles in upsurge of mobile device ownership among students in Nigeria. The State Government of Osun commenced distribution of tablet devices among the senior secondary school student in the state. In the same vein, University of Ilorin began its 1:1 mobile computing campaign in May 2014 by distributing tablet pc to fresh undergraduate students (University of Ilorin, 2014).

Despite this rapid increase in mobile devices ownership among the undergraduates, there is this need to provide indigenously learning materials, like mobile applications. Several students use own devices for pleasurable activities like playing games, watching movies, taking 'selfies', financial frauds, etc. (Yusuf, et al., 2015). Despite inherent promises that mobile learning comes with, Nigerian universities, to the best of the researcher's findings, little have been done in the area of design and development of mobile learning Apps for Android devices to serve as learning material. Mbanusi (2012) developed a mobile learning App using the Java Micro Edition, (J2ME) programming language, which run only on S40, Java phones, thereby incompatible with contemporary smartphones (Blackberry, Android, IOS, etc.). In advanced countries, studies have shown that the development of different mobile applications like blackboard, desire2learn, mobl21, and so on had helped to improve students' performance in learning (Barbour, Grzebyk, & Eye, 2014; Ishtaiwa, 2014). Therefore, there is need for Nigerian educators to harness the opportunities in mobile learning and create contextually relevant curriculum-based mobile learning apps for all courses offered in Nigerian universities. Therefore, this study was embarked on to explore the potential of developing a mobile App on a General Studies (Use of Library) which is compulsory course offered by undergraduates in Nigerian universities. In a more explicit term, the study attempted to focus more on the processes involved in the development of an android-based mobile learning application as guided by the element of the ADDIE model of instructional development.

Methods

The study utilized a design-based approach, entailing the use of ADDIE model of instructional system design in guiding the development of mobile learning application for Undergraduates' GNS Use of Library. Each of the stages of the ADDIE model- Analysis, Design, Development, Implementation and Evaluation- was religiously followed and documented in order to help fabricate a quality, instructional worthy mobile application. Although, the ADDIE model has five stages, as identified earlier, the first three stages; analysis, design and development were captured in the development process while the other two stages; implementation and evaluation, were captured in the usability process. However, this paper focuses on the development process.

Analysis: At this stage, the need analysis and task analysis were conducted. During the need analysis, an attempt was made diagnosing the need for mobile app students' performance. In the task analysis, a framework of the whole research process was proposed by the research. The researcher looked futuristically on the possibility and feasibility of developing the Mobile App and a timeline was drawn,

questions were being asked and searches were made by the researcher on devising the easiest and cost-efficient method of developing a mobile app that will run on Android devices among several options.

Design: This is the second stage in the development process of the GNS Mobile App. In this stage, the researcher began with brainstorming on content selection, the GNS (Use of Library) was later chosen after considering many other options available. The decision was based on the availability of a standardized textbook on the selected content. A letter was therefore written to the appropriate authority for the permission to use the part of the content of the text, which was duly granted. The selected textbook consists of eight chapters, out of which three were purposively selected. The textbook was then digitalized, and its content was formalized for portability, which is the hallmark of mobile learning concepts. A comp was designed by the researcher which would later form the plan in which the user interface would be developed on. The researcher also validates the designed comp by seeking the opinion of educational technology experts and some randomly selected students. Suggestions and the criticism of the validators were used in further improving the designed comp. For evaluation aspect, M3 evaluation framework was adopted to evaluate GNS mobile app. In this regard, a mail was formally sent to one of the authors of the framework (Mike Sharpels) for approval to use the model, which was unreservedly granted. Resources like jQuery Library, jQuery Mobile, jQuery Theme roller, and graphics were all sourced online, and were downloaded at no cost.

Develop: After the design phase comes the development phase. The researcher opted for a cross-platform development technology for the development of the mobile App. Cross-Platform technology is a cheap alternative to developing App by using the native language for each of the operating systems. For instance, Android is developed on Java, IOS on Objective C, and Blackberry on C. which implies that different codes will be written to accommodate the three platforms, which is very expensive and complex to maintain. Cross-platform technology allows the programmer to code in Hyper Text Mark-up Language Five (HTML5) with Cascading Style Sheet (CSS3) and JavaScript, and this will be processed through a third party build service (Cordova) into any of the O.S. platforms as shown in Figure 1, thus making it more cheaper and time friendly.

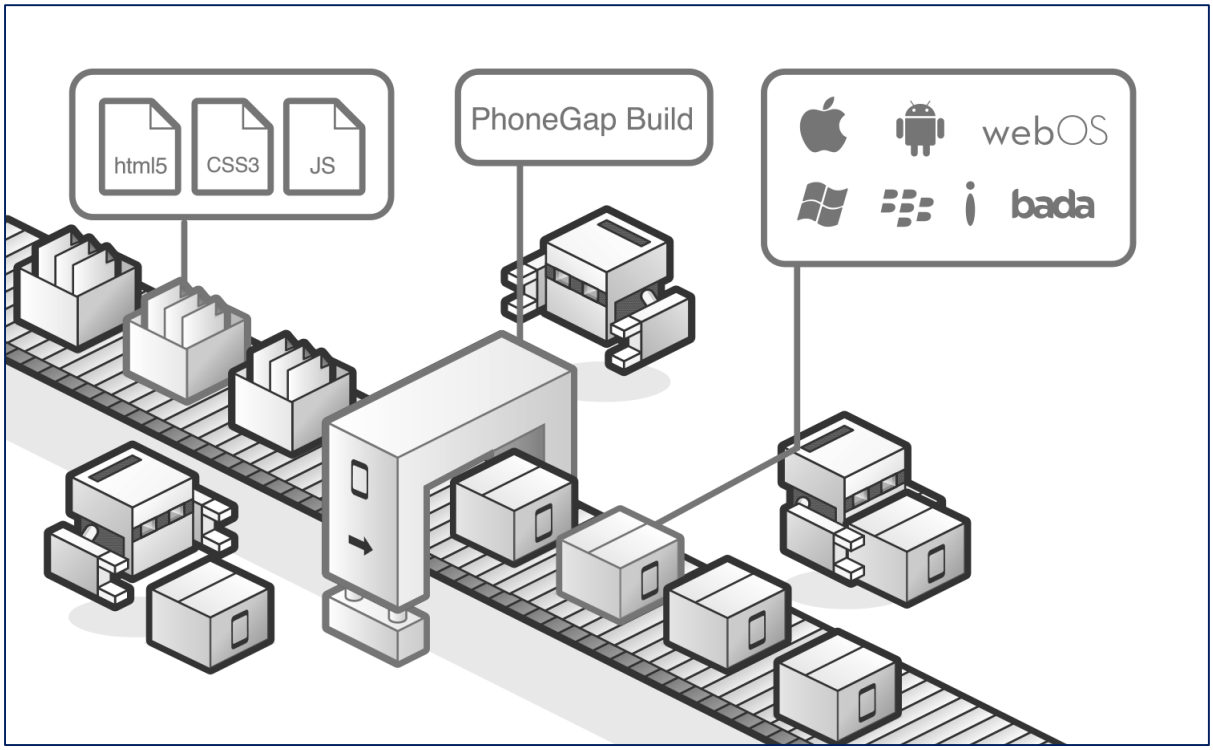

Figure 1: An Illustration of Cross-Platform Build Technology (Phone Gap/Cordova)
Source: (Stack Exchange, 2013)

HTML5 was the code used in designing the basic structure of the user interface, CSS3 was used to add flesh to the skeletal structure produced through HTML5. The colours and positioning of the elements of the HTML is achieved through the use of the CSS. JavaScript is used in deploying client-side interactivity in the App. A JavaScript library, jQuery and jQuery mobile were utilized as a form of shorthand to long JavaScript code, and this helped the researcher to achieve more with little codes. Each of these libraries were embedded in the head section of the HTML5 code, to allow for quick and optimal functionality, as shown in the code snippet in figure 2.

```
<!DOCTYPE html>
<html>
    <head>
        <meta charset="utf-8" />
        <meta name="format-detection" content="telephone=no" />
        <meta name="msapplication-tap-highlight" content="no" />
        <!-- WARNING: for iOS 7, remove the width=device-width and height=device-height attributes. See
        https://issues.apache.org/jira/browse/CB-4323 -->
        <meta name="viewport" content="user-scalable=no, initial-scale=1, maximum-scale=1, minimum-scale=1,
        width=device-width, height=device-height, target-densitydpi=device-dpi" />
        <!--<link rel="stylesheet" type="text/css" href="css/index.css" />-->
        <link rel="stylesheet" href="themes/latest_koldaf.min.css" />
        <link rel="stylesheet" href="themes/jquery.mobile.icons.min.css" />
        <link rel="stylesheet" href="css/jquery.mobile.structure-1.4.5.min.css" />
        <link rel="stylesheet" href="css/customGui.css"/>
        <title>GNS APP</title>
        <script type="text/javascript" src="cordova.js"></script>
        <script type="text/javascript" src="js/jquery-1.11.1.min.js"></script>
        <script type="text/javascript" src="js/jquery.mobile-1.4.5.min.js"></script>
        <script type="text/javascript" src="js/myAddOn.js"></script>
        <script>        //$( document ).on( "pagecreate", "#main_page", function()
            //window.localStorage.clear();
        </script>
    </head>
```

Figure 2: A code snippet of the HTML 5 used in the mobile learning app development

Adobe Fireworks that is part of the Adobe Creative Suite was used in handling the graphics and creating a Portable Network Graphics (PNG) files that were used for illustrations in the App. All coding (HTML, CSS, JavaScript) were done using the Adobe Dreamweaver CS6. The App was however previewed live on the browsers (Mozilla Firefox and Google Chrome) to test for the user interface display while the code is being written.

The initial build of the app was done locally using Eclipse (Juno version) with MobiDev plugins, and a test version was developed and installed on the researcher's device. Validation of the prototype was done by three computer experts (two system analysts and a programmer) and three educational technology experts. The prototype was validated with respect to its performance on various devices, loading time, on-screen display, file size, font legibility, usefulness for instruction, logical and sequential organization of content. Comment and suggestions were strictly adhered to, and this helped in modifying and minifying the codes in the subsequent build. Features like self-quiz was also added based on the recommendations of the validators.

Discussions and Conclusion

Development of mobile learning application is a rigorous process which must be carefully conducted. Despite the inherent benefits of mobile apps in teaching and learning, a bad developmental process can impede the actualization of these benefits. It is however worthy of note that development models should be harnessed in the development of mobile app. In this study, the development was guided by the ADDIE model. One of the major threat to educational technology development and integration in Nigeria and other developing countries is identified as cost (Gupta, 2016; Agbata, 2017). Therefore, a careful attempt was made at developing the mobile app at the lowest possible cost. The analysis phase of the ADDIE model which consist of cost benefit analysis was deployed to analyze plethora of mobile app development methods, and then come out with the most cost effective one. Some of the development method includes the use of expensive software, while some requires subscription into cloud-based services

at certain cost. The cheapest method arrived at, is the coding method which only require a text editor and other open source applications (Eclipse, MobiDev plugins, and Cordova).

Conclusively, mobile learning application development should not be a sole effort of the developer. As observed in this study, subject matter expert, computer experts, educational technology experts and even the intended users (students) where all co-opted into the development phase. Collaboration among the experts and proposed users went a long way in further improving the quality of the prototype in the subsequent development of the app.

Recommendation

Based on this study, the coding method is strongly recommended for developing mobile learning application. The method is cheap and further enhancing the programming skills of the developers. Development of mobile learning app should be guided by a model, to achieve a better result. ADDIE model was adopted in this study, other models like, AGILE model, Waterfall Model, etc. can also be tried. Mobile application development should not be done in isolation, efforts should be made to carry along other relevant professionals to further improve the quality of the intended application.

Mobile learning as a technology-enhanced learning is an innovation to teaching and learning that have come to stay. It is however imperative for educators at all levels to embrace it and begin to develop applications in this area. More than just developing the mobile app, teachers should liaise with other stakeholders, like instructional designers, programmers, graphics artist, User Experience experts, etc. to come up with an efficient and effective app useful for instruction.

It is therefore a high time that Nigerian educator began to leverage on the use of diverse open source and low-cost platforms to create an indigenously crafted mobile learning app, to help augment the face to face classroom teaching and learning. Also, the ADDIE model, is still a very relevant process of developing instructional packages, when all the elements in the model are judiciously harnessed, a quality instructional product can be guaranteed. Tertiary institutions in Nigeria should also venture into development of mobile learning applications to supplement their teaching, and to help decongest large classrooms in general courses like GNS. This will go a long way in actualizing the objective of the course as stated by the NUC and justify the inclusion of the course in the Basic Minimum Academic Standard (BMAS) for the Nigerian Universities.

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