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THE USE OF MOBILE APPLICATIONS FOR RESEARCH ACTIVITIES BY POSTGRADUATE ENGINEERING STUDENTS IN FEDERAL UNIVERSITY OF TECHNOLOGY LIBRARIES IN NIGERIA

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Abstract
The research studied the use of mobile applications on research activities by postgraduate engineering students in federal university of technology Libraries in Nigeria. The research centred on two (2) objectives. Survey research design was adopted for the study. The population of the study was 1,695 postgraduate engineering students. The sample for the study was determined using Taro-Yammen sample formula. The sample size was 318 postgraduate engineering students. Questionnaire was used to collect data. Descriptive analysis was used. The findings showed that level of postgraduate engineering students' research activities is high. The findings also revealed mobile applications such as WhatsApp, Zoom, Telegram, Skype, Facebook, Websites, Google, Blogs and YouTube as the mobile applications that enhances the use of electronic information resources of postgraduate engineering students. The research concluded that embracing mobile applications effectively, postgraduate engineering students can leverage technology to advance their research endeavors and contribute to the knowledge and innovation in their respective fields. Therefore, improving network infrastructure and connectivity on

campus, promoting awareness and training programs on the effective use of mobile applications, and fostering collaborations between developers and researchers to create tailored mobile applications that address specific research needs are germane.
Keywords: *Mobile-applications, Research activities, Postgraduate students, FUT, Engineering*

Introduction

The university is an environment saddled with the responsibility of teaching, learning, research, knowledge creation, and community services. Universities promote teaching, learning and research as essential activities in higher education systems. This is undoubtedly geared towards improving learning, dissemination of knowledge, increasing student research activities, socio-economic development, innovation, and producing highly-skilled manpower. University libraries manage and provide theses, dissertations, articles, abstracts, indexes, conference proceedings, textbooks, and other reference materials which assist students and academic staff to produce a better and quality research project which ultimately contribute to national development in diverse areas (Anyim, 2018). Universities serve as the major strength for the growth and development of a nation as it also serves as the citadel of learning where students undergo vigorous research activities and discoveries to meet society's needs and expand the frontier of knowledge.

Postgraduate students' research activities involve collecting, searching and saving information for assignment, thesis, project, dissertation, seminar, and conferences and also predicts possible results through the use of research findings. Research gives an understanding and explanation of a situation and shows the way into getting knowledge to fill the gap identified by the researcher. Ifedili and Omiunu (2012) defined research as a studious inquiry or examination especially investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws. It is an academic exercise geared towards reviewing and developing new theories and possible solutions to existing problems. Research activity is one of the driving forces in the knowledge economy and national progress, this is because it is crucial to the existence of universities and it serves as the fundamental process of knowledge acquisition. Research activities are essential for students to learn effectively with a view to seeking and identifying solutions to problems. Research is indispensable within the university environment since it serves as one of the major determining factors in the educational quality of an institution.

Research activity skill gives postgraduates and other categories of students

the opportunity to develop a professional approach to scientific and research skills and evaluate evidence that applies to research problems, observe, evaluate information, and bind it with research problems. Research also help to determine and evaluate conclusions of the research, inform colleagues, tutors, and audience about the processes and results, and develop educational skills that can be used in all fields (Tymochko, 2019).

Mobile Applications (Apps) are software developed for use on mobile devices and made available through Application stores. Mobile Applications have developed into a significant industry and Apps stores have become highly competitive places. Most of these apps are often referred to a smartphone app. Smartphone apps are software applications that run on a mobile phone. Smartphones are phones that have the capability of a computer as well as the ability of a normal mobile phone. Apart from being used for calling, smartphones also used as data storage media, media for displaying data, GPS, content creator (using the phone camera or creative applications), document-making, entertainment, games, and other smart functions. The characteristics of the smartphone include having mobile operating systems (OS) such as Android, IOS, web feature, open-source, enhanced hardware, such as touch screens, built-in keyboards, and mobile PC (Sharma, 2012). Smartphones are used by many people to assist their daily activities, starting from business, health, entertainment, and education. Academia use smartphones to facilitate their activities while on campus, start checking lecture schedules, contact colleagues, change documents, collaborate, and save various jobs to do elsewhere. Most mobile application works perfectly on smartphones, mini computers like iPad, Note Book, laptop, and even desktop.

Mobile applications are filled with various kinds of applications that support learning activities on campus, especially the communication applications, like WhatsApp, LinkedIn, Facebook, Telegram, Zoom, Skype, and Google Classroom; applications to search the web namely Chrome, Firefox, Safari; application for storing, editing documents WPS office, Google drive; calendar, translator, note and others. In the learning process, these apps are used to carry out class lectures, library observation, a professional practice or internship, and e-learning. Lecture materials, and assignments are delivered through class lectures and e-learning. In addition, the mobile Applications have a shared communication path between lecturers, students, and admins, where they can share and upload information about timetables, lecture material, and assignments. There are also WhatsApp groups between students and lecturers, which allows for a new way of learning and collaborating (Mulatingsih and

Zuntriana, 2018).

Objectives:

1. determine the levels of research activities of postgraduate engineering students in Federal University of technology libraries in Nigeria;
2. find out the mobile applications that enhance electronic information resources utilisation for research activities by postgraduate engineering students in federal university of technology libraries in Nigeria

Review of related Literature

Concept of research activity

The conduct of research is one of the main activities in tertiary institutions. Research activity is geared towards student's participation in conducting research. It involves the development of one's knowledge which leads to a new knowledge and transformation. Avdiu (2017) asserted that research activities is the main pillar in every development and transformational process for every society, especially for the student development and transformation process. Research activities indicate that postgraduates and other group of students identify a research problem which is worthy of investigation. Thus, research activity elaborates the processes of teaching, learning research and cultural development. Research activities represent student's dynamic process of personality growth which is characterized by student's self-organization and self-fulfillment while carrying out research in their respective institutions, (Belova & Belov, 2016). In addition, research activity is one the criteria for the award of certificate in all higher institutions of learning as it is globally accepted that teaching, research and community service is the main pillar and functions of higher institutions of learning.

Research activities involves specialized forums which leads to the production of academic writings that involves projects, thesis and dissertations, seminar papers, scientific seminar, book review sessions, conferences and workshop which is of a great benefit to researcher's educational attainment (Razeghi, 2019). Research activities increases postgraduate students' knowledge of the social, economic and technological advancements which researchers mainly depends on.

Research activity findings knowledge has become one of the driving forces of national development in the "information and knowledge economy". However, Kutumova and Kushnir (2014) highlighted the benefits of higher professional education to include several areas for applying and implementing

types and forms of students' research activities which include enriching traditional academic forms of educational process organization; lectures, seminars, practical and laboratory studies, by performing research-type tasks; developing extra-curricular forms of involving students in scientific activities, that includes writing scientific reports, articles, preparing reports and scientific conferences.

This corroborates with the study of Nwakwa (2015) that highlighted the benefits which accrue from research activities to include the following; Quantitative education that makes acquisition of useful skills, desirable values, knowledge, attitudes, ideas and competencies necessary for self-reliance which can only be possible through adequate research work. It also results to qualitative instruction, articulate and confident graduates for the society's developmental activities; improvement in educational practices through research. Therefore, adequate research leads to the discovery of new techniques, ideas and ways of doing things which will in turn transform the society educational activities at large.

Mobile Application

The app is for application, or software that typically runs on a mobile device Zhu, Marques and Yoo (2015) asserted that mobile phone maker, industries, companies offer more advanced computing ability and connectivity than a contemporary basic feature phone. A Smartphone is an example of one of them, Smartphone that offers multiple applications to the user and a tablet is essentially a lightweight mobile computer with a touch screen. Apple iOS and Google Android are two examples of popular Smartphone/tablet platforms. Mobile device companies and computer scientists define the term "Mobile app" in different ways some definitions are listed below, as a small application that runs on a Smartphone and a tablet is called app. Different app development tools are needed for different operating systems (platforms). For example, Apple applications are typically developed within the X-code environment in Objective-C programming language and can be deployed to iPhone, iPod Touch, or iPad, whereas Android apps are typically developed in Java language and deployed to Android devices (Glassman, 2012).

Mobile applications are today very important for a great variety of activities and businesses. They avail users with the types of devices to use as the iPhone, blackberry, Android to mention but a few. Twum, *et al.* (2020) assert that Mobile applications (M-apps) are also known as an app. It is a type of application software designed to run on a mobile device such as a Smartphone or Tablet

computer. Every day, academic scholars are searching for innovative techniques in imparting knowledge to students.

Mobile applications assist in offering users similar services to those accessed on personal computers Rouse (2020). A mobile application can be referred to as an app, web app, online app, Smartphone app, or even iPhone app. Three types of mobile apps include Native, Web-based, and hybrid. Twum, *et al.* (2020) rightly points out the platforms of Mobile apps to include: WhatsApp, LinkedIn, Facebook, Telegram, Zoom, Skype, and Google Classroom. Rouse (2020) defined a Mobile app as a software application, developed specifically for use on small, wireless computing services, such as smartphones and tablets, rather than desktop or laptop computers.

Mobile Apps are designed with consideration for the demands and constraints of the devices and also to take advantage of any specialized capabilities they have. A gaming app, for example, might take advantage of the iPhone's accelerometer. A mobile application, most commonly referred to as an application is a type of app software designed to run on a computer or mobile device, such as a smartphone or table computer. Mobile apps frequently serve to provide users with similar services to those accessed on PCs. Apps are generally small, individual software units with limited functions. A mobile app also may be known as an app, web app, online app, iPhone app, or Smartphone app that is equipped with innovative functionalities and unique features for easy delivery of content, information sharing, and collaborative work over the internet. Again, a mobile app according to Wikipedia is referred to as a computer program or software app designed to run on a mobile device such as a phone, tablet, or watch. This use of app software was originally popularized by Apple Inc. and its App Store in 2008, which offers thousands of apps for the iPhone, iPad and iPod Touch.

Types of Mobile APPS

Mobile Apps can be classified into three main categories

i. Native app
ii. Hybrid app
iii. Web-based app
iv. Native APP

According to Rouse, Margaret in Wikipedia (2020), applications targeted towards a particular platform are known as native apps. Therefore, an app developed to be used by an Apple device cannot be run by an Android device. As a result, most businesses develop apps for multiple platforms. While developing native apps, professionals incorporate best-in-class user interface modules. This is said to have accounted for better performance, consistency, and good user

experience. Users also benefit from wider access to app programming interfaces and make limitless or endless use of all apps from the particular device. The rationale behind the creation of such apps is to ensure the best performance by a specific mobile operating system.

Hybrid APP. On the hybrid app, Rouse has this to say, that it is a mix-up of the native and web-based apps. Apps developed using Apache Cordova, Xamarin, React Native, Sencha Touch, and other similar devices fall into this category. These are made to support web and native technologies across multiple platforms. These apps are said to be easier and faster to develop. Although despite these advantages, hybrid apps exhibit low performances, as often, apps fail to bear the same look-and-feel in different mobile operating systems.

Web-based APP. A web-based app captures a minimum memory space in user devices compared to native and hybrid apps. Since all the personal databases are saved on the internet servers, users can access their desired data from any device using the internet facility (Rouse, 2020).

Electronic Information Resources that are Available and Utilised via Mobile Application

Electronic databases are vital in modern-day research in universities. Electronic databases are usually collections of e-journals and e-books to provide cost-effective access to these e-resources to the end-users (postgraduate students). The contents of each database vary from discipline to discipline. Examples are MEDLINE, Science Direct, AGORA, HINARI, Lexis-Nexis, EBSCHO HOST among others. The e-databases have provided many possibilities and opportunities in providing faster and quicker access to electronic information resources using mobile devices Tiemo (2016).

Types of Electronic Information Resources utilised via Mobile Application

The emergence of electronic information resources (EIRs) has greatly transformed information handling and management in Nigerian university communities. Electronic information resources have gradually become a major resource in every university community. Electronic information resources are provided in electronic form, and these include CD-ROM database, online databases, online journals, OPACs, Internet and other computer-based electronic networks (Quadri, *et al.*, 2014).

The various types and forms of e-resources in university libraries are: e-databases, e-journals, e-data archives, e-manuscript, e-maps, e-books, e-

magazines, e-thesis, WWW, e-newspapers, e-research reports, and e-bibliographic databases (Ankrah & Atuase, 2018). The major benefit of electronic resources in the university library besides ease of access to the needed information is that access can be done using mobile technology applications by library users as well as engineering postgraduate students in their offices/laboratories or at homes without physical visit to the library. Thus, electronic resources promote efficiency in dissemination of information for research purposes in universities (Thanuskodi, 2012). Different types of electronic resources that are used by library users including postgraduate engineering students include: e-journals, e-books, online databases, electronic conference proceedings and CD-ROM databases (Amankwah, 2014).

Developments in contemporary Nigerian libraries have witnessed another dimension in terms of acquisition, processing, storage and dissemination of information. It has offered librarians and information users' different options in carrying out library routine operations. The traditional practice in the then known library, where services could only be performed within the four walls of the library is fast becoming a thing of the past. Library services in the contemporary world can be rendered without the user visiting the library physically. This is courtesy of Information and communication Technology facilities of which the mobile phone is an example. The mobile phone applications have simplified the learning process and learning can take place at anytime and anywhere. Similarly, library resources and services can be accessed remotely without necessarily visiting the library.

The traditional face-to-face system where postgraduate students and other library users must be physically present to consult or access library resources is no longer a prerequisite in the contemporary library environment. Thus, postgraduate students may not show up physically in the library questions, but may digitally transmit requests to the library from a remote location. The postgraduate students will be attended to via the same media. Libraries have the responsibility of providing effective support services to students in their dispersed locations, be it within the country or outside. The library being a service agency, normally tailored its services to reflect the vision of its parent institution by diversifying its resources and services to address the teaching, learning and research needs of staff and students, irrespective of their locations. The need to efficiently carry out its obligations and take library resources and services to postgraduate students and other library users have brought to the fore front the desire to continuously explore mobile phone applications such as Twitter, Whatsapp, Face book, Skype and others as communication infrastructure capable

of creating an interface between the library, its resources and its users.

The mobile phone has various applications that are used for different purposes. Essentially, all mobile applications are meant to enhance personal, interpersonal, group and intergroup communication. Information agencies like libraries and information centres are good avenues where mobile phone applications can be used to enhance service delivery to users. Such Applications like Twitter, WhatsApp, Face Book and Skype can be used by libraries as the interface between the library and the library users.

The use of Mobile Phone Apps to access library information resources and services requires availability and accessibility to electronic information or virtual library. Consequently, many academic libraries in the developing countries, lately, are responding to the new digital environment. This has become imperative because of such trends as: rise of online instructions, globalization, postgraduate students' desire for information, access to social media and networking environment anytime anywhere, (Ogbebor, 2013). In Nigeria, for instance, the Federal Government, through the Ministry of Education and the National University Commission, (NUC) introduced the National Virtual Library Project as a catalyst to digital revolution in Nigeria university libraries. This project commenced with eleven university libraries and a model virtual library being established at the National University Commission as the hub, but the projects were stalled by inadequate funds, (NUC, 2001). Mobile phone applications therefore are essential in boosting the morale of postgraduate students towards the use of library electronic resources to meet their information needs.

University libraries provide their library users with electronic resources that are more comprehensive and scholarly than most Web sites provide. According to the University of Chicago Library as cited in Omosekejimi, *et al.* (2015) listed some of the electronic resources should be available at every university library's disposal. These include electronic books, electronic journals, online databases, CD ROM databases, Online Public Access Catalogue (OPAC), and Internet Sources these resources can be accessed on the mobile device at all times.

Research Methodology

Survey research design was adopted for this study. The population of the study was 1,695 postgraduate engineering students in federal university of technology libraries in Nigeria. Simple random sampling technique and sample size was determined using Taro Yammen formular. The sample size was 318 respondents in all the federal university of technology libraries in Nigeria. The

research instruments used for collecting data for the study were structured questionnaire titled" mobile application-based user education programme and utilisation of electronic information resources questionnaire (MABUEPEIRQ) and observation checklist. The data collected was analysed using descriptive statistic using frequency count, mean and standard deviation. Statistical Package for Social Science (SPSS) was used for the analysis.

Data Analysis

Table 4.1: Level of research activities of postgraduate engineering students in Federal University of technology in Nigeria

S/N	Statement	VH	H	L	VL	$\bar{x}$	SD	DECISION
1.	Conference papers	116(38%)	106(35%)	48(16%)	36(11%)	2.99	0.07	High
2.	Workshop attendance and presentation	61(20%)	77(25%)	58(19%)	109(36%)	2.30	0.08	Low
3.	Seminars	40(13%)	68(22%)	94(31%)	103(34%)	2.15	0.072	Low
4.	Thesis and Dissertations	176(58%	129(42%)	0(0%)	0(0%)	3.58	0.03	Very high
5.	Journals publications	113(37%)	74(24%)	57(19%)	61(20%)	2.79	0.08	High
	Average Weighted Mean					**2.76**		

Key: VH = Very High, H = High, L = Low, VL = Very Low. Decision is made to each response based on the mean score >= 2.5.

Table 4.3 showed the level of postgraduate engineering students' research activities at the Federal University of Technology in Nigeria. The highest mean score 3.58(0.03) of the postgraduate engineering students showed a very high level of research activities in Thesis and Dissertations. In the same vein, the table showed that postgraduate engineering students' level of research activities in conference papers and journal publications is high with a mean of 2.99(0.07) and 2.79(0.08) respectively. However, the table revealed that the lowest mean score was 2.15(0.072) for postgraduate engineering students in seminars. Also, the level of research of postgraduate engineering students in workshop attendance and presentation with 2.30(0.08).

Table 2: Mobile application that enhances the use of electronic information resources of postgraduate students
Key [√] =Availabl

Mobile Applications	Name of Federal University of Technology Libraries											
	Ibrahim Badamasi Babaginda Library FUTMinna		Ibrahim Badamasi Babaginda Library MAUTECH		Federal University of Technology, Owerri Library		Adebimpe Ike Library, ATBU		Albert Adeoye Ilemobade Library, FUTA	
	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA
WhatsApp	√		√		√		√		√	
Zoom	√		√		√		√		√	
Telegram	√		√		√		√		√	
Skype	√		√		√		√		√	
LinkedIn		-		-		-	√		√	
Facebook	√		√		√		√		√	
Websites	√		√		√		√		√	
Google	√		√		√		√		√	
Blogs	√		√		√		√		√	
YouTube	√		√		√		√		√	
MySpace		-		-	√		√		√	
Widgets		-		-		-		-		-
Flick		-		-		-		-		-
Instagram		-		-		-		-		-

The findings of this study revealed that mobile applications such as WhatsApp, Zoom, Telegram, Skype, Facebook, Websites, Google, Blogs and YouTube are mobile applications that enhances the use of electronic information resources of postgraduate engineering students in the federal university of technology libraries studied. This could be because these mobile applications are automatically installed on mobile phones and are used on daily basis by individuals including postgraduate engineering students.

However, LinkedIn enhances the use of electronic information resources of postgraduate engineering students in only Adebimpe Ike and Albert Adeoye Ilemobade Libraries of ATBU and FUTA respectively, while MySpace enhances the use of electronic information resources of postgraduate engineering students in Federal University of Technology Owerri Library, Adebimpe Ike and Albert Adeoye Ilemobade Libraries of ATBU and FUTA.

Surprisingly, Widgets, Flick and Instagram do not enhance the use of electronic information resources of postgraduate engineering students in all Federal University of Technology Libraries studied. This could be because they are mobile applications that are popular with images, pictures and short video clips.

Level of Research Activities of Postgraduate Engineering Students

The findings of the study showed that postgraduate engineering students in federal university of technology level of research activities is high. The findings showed that postgraduate engineering students highly engaged in conference paper presentation, journal publications in both local and international publishers. Also, postgraduate engineering students highly engaged in thesis and dissertation since it is a pre-requisite for graduation. The findings were supported by Onwukanjo, (2022). The author asserted that postgraduate engineering research activities involve conferences, workshops, seminars, writing of theses and dissertations, scientific interactions with students and professors and then publishing in journals which is a research output. In other word, Postgraduate engineering students in all the universities in Nigeria are engaged in research as requirements in postgraduate programme before conferment with masters or PhD degrees respectively.

Mobile Application that Enhances the Use of Electronic Information Resources

The findings revealed that mobile applications such as WhatsApp, Telegram, LinkedIn, Zoom, Skype, Facebook, Website, Google, Blogs and YouTube enhanced postgraduate engineering students' use of electronic information resources. The findings are supported by James and Emmanuel

(2017) who investigated mobile phone apps and the utilisation of library services in the university of Calabar library, Nigeria. The findings revealed that there was a significant relationship between Tweeter apps and the utilisation of library services, (r=0.57*, P<.05, df=223, critical=.138); there was a significant relationship between Whatsapp and the utilization of library services, (r=0.47*, P<.05, df=223, r-critical=.138); there is a significant relationship between Facebook apps and the utilization of library services, (r=0.59*, P<.05,df=223,r-critical=.138); and there is a significant relationship between Skype apps and the utilisation of library services, (r=0.51* , P<.0.5, df=223, r-critical=.138). From the result of the study, it was recommended among others that the use of mobile phone apps as communication infrastructure should be encouraged in the University of Calabar Library. Similarly, Ogunbodede and Ivwighreghweta (2020) investigated the use of social media for effective library service delivery in university libraries in Edo and Delta States. The findings revealed that the majority of the librarians mostly use Facebook and Whatsapp platforms in providing library services. Regarding the library services that are offered/provided using social media, it was discovered that most of the respondents use social media platforms to create awareness about library resources and services and also to share library news and events.

Conclusion

In conclusion, the use of mobile applications in research activities among postgraduate engineering students in the Federal University of Technology in Nigeria presents a promising avenue for enhancing research productivity and accessibility. The findings of this study provide insights for academic institutions, policymakers, and researchers to understand the role of mobile applications in supporting research activities and to develop strategies that maximize the benefits and address the challenges. By embracing mobile applications effectively, postgraduate engineering students can leverage technology to advance their research endeavors and contribute to the knowledge and innovation in their respective fields.

Recommendations

Based on the findings, the study proposes several recommendations to enhance the use of mobile applications and research activities among postgraduate engineering students:

1. Improvement of network infrastructure and connectivity on campus, promoting awareness and training programs on the effective use of mobile applications, and fostering collaborations between developers and

researchers to create tailored mobile applications that address specific research needs.

2. There is need to commend the level of research activities of postgraduate engineering students. However, more mobile applications should be harnessed for quality research output.

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