Mobile Devices' Features and Usability: The Nigerian Utilization Experience

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Abstract *- This research paper assesses the usability and utilization of mobile phones among users in Nigeria using theories and techniques of technology. The work compares the functions embedded in conventional cell phones and smartphones with their utilization. Instrument for data collection was designed on Google forms circulated online via email and shared on Whatsapp groups; facebook and copies of the survey were also administered to randomly selected number of users in the South West, Nigeria. A total number of 650 responses were considered for the study and selected fields for data modeling and analysis include gender, educational status, age, social and employment status for users who are not students. Five hypotheses were formulated and the initial analysis of the data was done with electronic spreadsheet on Google respondents' analyser and further subjected to Statistical Package for Social Sciences (SPSS). T-test distribution of means and standard deviations method was further used to measure the variability of the conditions. The results at 0.05 level of significance show that there was no significant difference in the usability of the features of mobile devices among Nigerians across gender and educational status but on age, social and employment status of users. On utilization measurement, the study reveals that users do not sufficiently harness the resources and the in-built functions of their mobile devices from the conventional cellphones to the sophisticated smart devices. These results point end-users of mobile products to the need to utilize the resources embedded in their portable gadgets. These findings are expected to have positive innovative implications for research in mobile computing with particular reference to developing countries and their usability, consumption and utilization of mobile communication products.*

Keywords — *Mobile Devices, Usability, Utilization, Smartphone, Features, Nigeria*

I. INTRODUCTION

With the advancement of mobile technology, mobile devices have become thrived globally, and Nigeria is no exception. According to Danbatta (2016), there are about 722 million mobile phones in Africa, with 127 million smartphones [1]. Currently, the common mobile phones, popularly called cellphones or handsets have about 94 percent penetration in Nigeria [2]. The African Infotech Consulting (AIC) reports show that in 2016 alone smartphones gained penetration in Nigeria at about 30 percent while feature phones had a 70 percent entry [3]. This figure was projected to increase to about 34 million in 2018. The rapid penetration of this mobile technology has engineered communication system in the developing countries of Africa in no small measures, Nigeria inclusive. It has successfully replaced the analog landlines and the African continent is fast becoming a great part of the digital story of the 21st century.

Today, mobile technologies are finding their ways into African medicine, African theology/religion, African fashion, music and entertainment, African culture and sociology, African governance and activism, same to commerce and industries, etc. The Massachusetts Institute of Technology's International Science and Technology Initiatives (MIT-ISTI) in 2017 described mobile technology in Africa as the fastest growing market with huge potentials. Wireless infrastructures are daily springing up in the continent to meet up with the pace of the global innovations. It is in the light of these, that this study seeks to investigate the utilization of these mobile devices and their embedded features among Nigerians.

II. LITERATURE REVIEW

Mobile devices have been described as a small-sized handheld computing infrastructure [4]. They include all categories of portable computing devices with the capability of performing more communication functions. They vary in sizes, functionalities, prices and models. Some are quite simple for only calls dialling and messaging, while others have these additional features like the smartphones, ipads, Personal Digital Assistants (PDAs), pagers and Personal Navigation Devices etc. [4] They offer ease of communication, localization, navigation, context-awareness, situation-awareness, sensing, access to information, fostered relationship, development and sharing of multimedia, etc. Table I makes a distinction of Cellphones and Smartphones

by features. According to Campbell and Choudbhury (2012), smart phones possess amazing features than the conventional cell phone [5].

TABLE I: FEATURE DISTINCTIONS BETWEEN CELL PHONES AND SMART PHONES adapted from [6]

Function/Feature	Cellphone	Smartphone
Send and receive telephone calls	Yes	Yes
Receive and store messages	Yes	Yes
Camera	Some	Yes
Calendar	Some	Yes
Address Book	Yes	Yes
Music Player	Some	Yes
Text-messaging	Yes	Yes
MMS	Some	Yes
Internet Access	Some	Yes
Email	Some	Yes
Voice dialing	Some	Yes
Bluetooth	Some	Yes
Audio/Video recording	Some	Yes
GPS	No	Yes
Office programs	No	Yes
Soft keyboard	Some	Yes
Context-awareness	No	Yes
Navigation/mapping	No	Yes
e-commerce	Some	Yes
Health management	No	Yes
Gyroscope	Some	Yes
WiFi/hoptspot	Some	Yes
Security manager	Yes	Yes
Task manager	Some	Yes
Video call	Some	Yes
Notepad	No	Yes

Mobile devices are broadly categorized into two: Firstly, as communication devices that allow interpersonal communications, group discussions, exchange of text messages, etc. Secondly, as media devices that enable sharing of audio, video and picture messages across different platforms [7]. Beyond these, a mobile device can be used to keep track of appointments and/or used as a reminders system; to send or receive e-mail, upload and download information on the Internet; play games, chat via instant messaging platforms or browse social networking sites; watch TV and locate others; etc. [8].

According to Pew Research Centre reports in 2015, cell phones are commonly called handsets. They have basic tools for performing simple functions that include short message service (SMS) and multimedia message service (MMS) [9]. Pictures and video taking with these types of phones have been the most outstanding activities by users. Examples of such devices are: Nokia 1100, Motorola DynaTAC, Motorola StarTAC, Samsung E250 etc. They have good batteries capacity but with less enhanced features. Meanwhile, smart phones are highly intelligent mobile devices, with cloud-interaction capability. They play great roles in supporting navigation with GPS, context-awareness, healthcare, with powerful sensing features [5]. They can access the internet and apps, social media, receive live news updates, play music and video, process banking transactions, provide security, etc. Examples of such phones are: iPhone, Blackberry, Windows or Android device. Most smart phones typically have soft buttons for tapping, swiping or waving-over. Three major mobile operating systems (MOS) have been identified as common among smart phones; these include: the Google Android which is the most popular MOS, Apple iOS found on Apple iPhones and Apple iPads, and the Windows OS which is owned by Microsoft Incorporated. Other MOS are Palm, BlackBerry, Symbian, Bada and Maemo.

A. *Theories of Mobile Technology*

Studies on mobile phones technology can be viewed in three different periscopes: the adoption, technology and use theories. The adoption theory seeks to explain the need for the adoption and consequent application of mobile technologies in solving the problems of mankind. It is concerned with identifying those areas of need that require technology application. In this work, our focus is on the technology (features/techniques) and (utilization) theories. Therefore, less emphasis would be laid on the adoption theory.

The techniques theory explores the features of mobile technology devices and their functions as would meet user's need. This identifies the components of the devices that can actually address the human problem areas. According to this theory, what has now culminated into a portable, handheld wireless but powerful device gained entry into the world's communication life in 1983 [10]. Since then, the device has improved tremendously in design, technology and functions. Presently, five generations of the mobile technology has been identified as depicted in Table II .

The first generation - 1G network, describes the analog telephone used in the early 1980s, characterised by circuit-switched technology and Frequency Division Multiple Access (FDMA).

TABLE II. FIVE GENERATIONS OF MOBILE DEVICE EVOLUTION [8, 11,12,13]

FEATURES	1G	2G	3G	4G	5G
Year	1983-1990	1990-2000	2000-2007	2007-2010	2011-present
Examples	Motorola DynaTAC, Motorola StarTAC	Sony Ericsson P800, BlackBerry Quark 6210	Smartphone	Apple, iphone, Ipads	Apple, iphone, Intelligent systems, Robots
Size	1kg, 88g	158g,136g	140g	140g	pint
Storage	Internal	Internal	Memory card/internal	Memory card/internal	Cloud storage
Bandwidth	19.2Kbps-100Kbps	300Kbps	2Mbps	2Mbps-1G	1Gbps & higher
Technology	Analog based mobile network. No data communication, only SMS	Relatively slow data connection/ Internet usage by phone	Broad bandwidth CDMA, IP Technology	Unified IP and seamless combination of broadband. LAN/WAN/PAN and WLAN	Unified and seamless combination of broadband. LAN/WAN/PAN / WLAN/ and www
Service	No camera, audio, video player	Camera, mail, audio, video player	High quality audio, video and data	Dynamic information access, wearable devices	Dynamic information access, wearable devices with AI capabilities
Core Network	No Internet	Limited Internet	Packet Network	Internet	Internet
Standards	-	-	WCDMA CDMA- 2000	Single unified standard	Single Unified Standard

The features in those devices were of very poor quality. The 1G technology was followed by the 2G devices which were introduced in the early 1990s. The 2G devices were actually the first cellular phones with better features for voice, messaging, radio, etc., made of a Compression- Decompression algorithm (CODEC) [13]. Over the course of years, the mobile technology has evolved from the 3G, 4G [18] to the present 5G. From the Table II, Smart phones appeared in the era of 3G networks with enhanced multimedia and communication features. These devices run with broadband connections. The 4G devices, like the LTEs are very much present in this age. Iphones, ipads have amazing functionalities and high intelligence and speed. The 5G can be described as work-in-progress, though great successes have been made so far in the technology and deployment. It is expected to span up to year 2020.

The utilization theory on the other hand focuses on the users or adopters of technology, basically exploring the usability and utilization of the features present in the mobile devices. A study by Matanhelia (2010) on cell phone use by young adults in India employed the use theory, which it identified as the gratification approach [10]. The study revealed that the category of the people under the study used their mobile devices majorly for communications which were mostly private conversations, news, entertainment and keeping relationship with peers, friends and members of the opposite sex.

Fidock and Carrol (2012) proposed a cycle of IT use as shown in Fig 1. The lifecycle of IT use specifies the phases which an IT product undergoes from introduction to the full utilization. The phases include the pre-use, initial-use and continued-use [14].

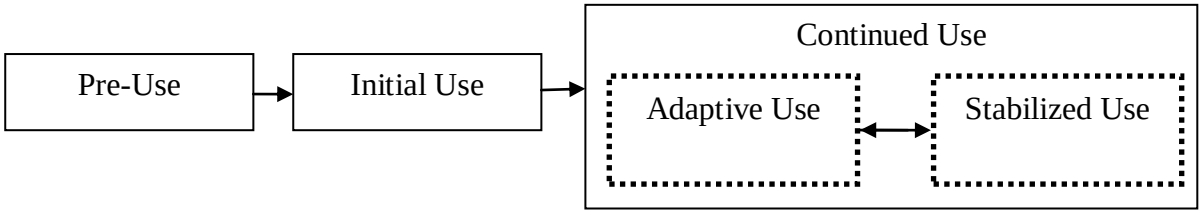

Fig 1.The Lifecycle of IT use [14].

The pre-use phase deals with a potential user, seeing and getting acquainted with the features of the technology from a distance without using it. It prepares the mind of the would-be user on a proposed system in view of understanding at the basic level of what the technology and its make-up would help achieve. This, apparently, is all about a forthcoming technique of doing things with ease or differently. With this preparatory knowledge, as the product arrives, the user begins an initial use of the features [15]. As the user enjoys the features, more are gradually learned and utilized continuously. Thus, the continued-use phase has two sub-phases, which are the adaptive-use and established-use phases. The user gets adapted to new features and eventually masters the use of most of them to effectively apply in various areas of need.

Applying the Fidock and Carroll's (2012) IT cycle on Nigeria utilization experience, the mobile technology usage experience in the context of this research work can be described to be in adaptive-use phase of the continued-use. This is obvious from the penetration rate and volume of patronage of mobile IT products. Albeit, such a vote cannot be given in respect of the established-use phase in Nigeria, until the full derivation of the potentials of these products and services would have been ascertained in the country. This is a case this study attempts to substantiate.

B. Mobile Technology in Nigeria

In Nigeria like in all other developing countries the mobile phone has been instrumental to the rapid increase in telecommunications accessibility. Before digital mobile telephony was introduced in Nigeria in 2001, the country had less than 500 thousand telephone lines. Today the story is different with the number of telephone lines in Nigeria now put at more than 30 million (Nigeria Technology Guide, 2006) [16]. The PRC survey in 2015, measured the penetration rate of mobile technology in selected African countries, with Nigeria being only second to South Africa. The mobile technology has plays key roles in politics and governance in Africa in general and Nigeria in particular. Recently, the World Bank earmarked on the sum of $50M USD investment in ICT infrastructural development and capacity building for Nigeria alone [17]. According to mobile telecommunications industry report for West Africa in 2012, Nigeria holds the largest share of over 95M subscribers out of the industry's estimate of 188M mobile subscribers for the West African region. These services are majorly provided by players like MTN, Airtel, Globacom, Etisalat, Orange, Tigo, and Vodafone, with the first four heavily present in Nigeria. The activities of government are no longer hidden to the citizens. Many political topics are being discussed daily on the social newsgroups and media. The security agencies have also adopted mobile technology to monitor and receive reports of operations of officers and members of the public on the go in Nigeria.

III. METHODS

The study adopted both primary and secondary sources of data collection. Questionnaires were designed on Google forms, distributed online via email and shared on Facebook and Whatsapp social platforms. Copies of the questionnaire were also physically administered. By adopting the online method of administering the questionnaire, the researchers ensured that biases that may arise from familiarity, forced-responses or interferences with the choices of the target population were carefully taken off. Furthermore, to avoid double entries, the respondents were made to submit the questionnaires with their email addresses. That way, the survey was designed to ensure no respondent with the same email address submitted more than once. The analysis of the data was done using Google survey analyser and SPSS.

A. Sample/Population

A total number of 650 respondents from selected cities in the South Western region of the country were considered for the study. Selected fields include: gender, educational status, age, social and employment status for users who were not students. 550 entries were collated from the online Google forms, 70 respondents were collated from the questionnaires physically administered while the remaining 30 respondents were from the face to face interviews conducted.

B. Hypotheses Formulation

The study developed and tested five null hypotheses as stated below:

H_{01}: There is no significant difference between phone's features and their usability by Nigerians.

H_{02}: There is no significant difference between phone's features usability and gender among Nigerians.

H_{03}: There is no significant difference between phone's features usability and social-employment status in Nigeria

H_{04}: There is no significant difference between phone's features usability and educational level in Nigeria.

H_{05}: There is no significant difference between phone's features usability and age in Nigeria.

These hypotheses were tested using the T-Test/Score of means difference and standard deviations to measure the variability of the conditions at 0.05 level of significance.

IV. RESULTS AND DISCUSSIONS

Results and discussion of findings from the analysis are presented in this section.

A. *Data Analyses*

The following are the analyses of the data.

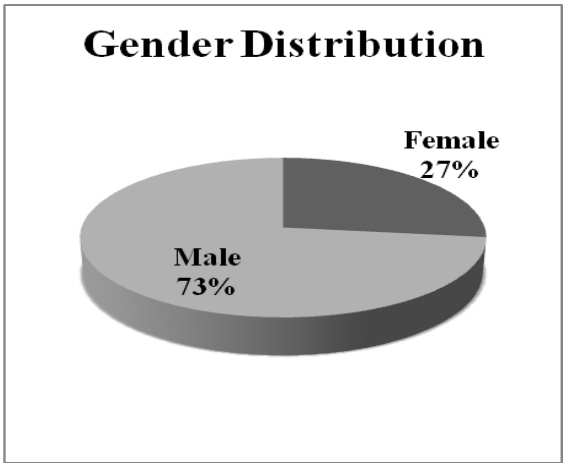

Fig 2: Gender Distribution of Respondents

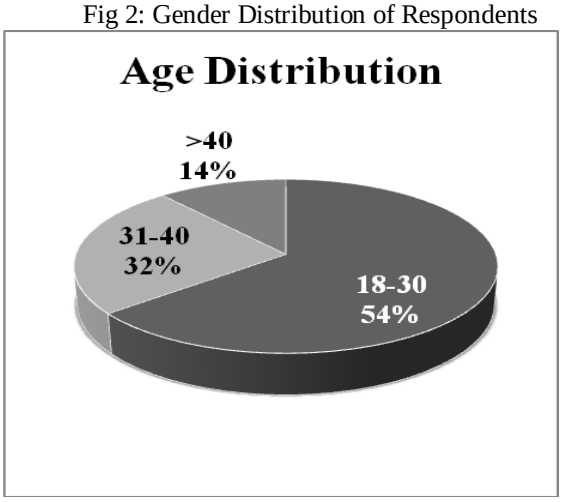

Fig 3: Age Distribution of Respondents

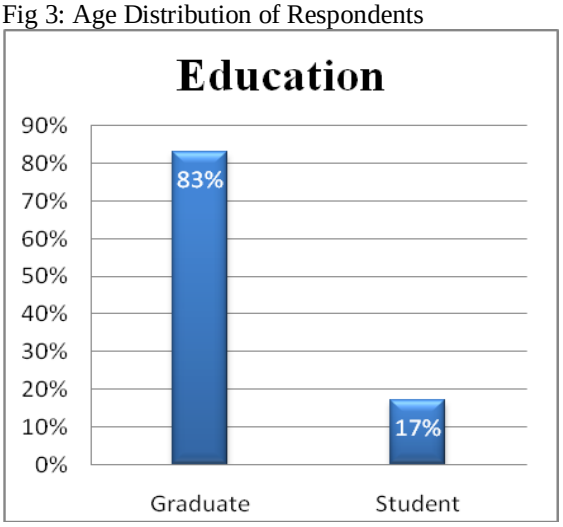

Fig 4: Educational Distribution

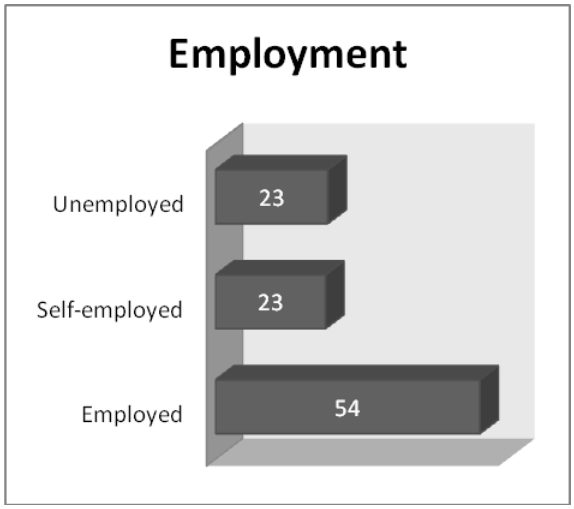

Fig 5: Employment Distribution

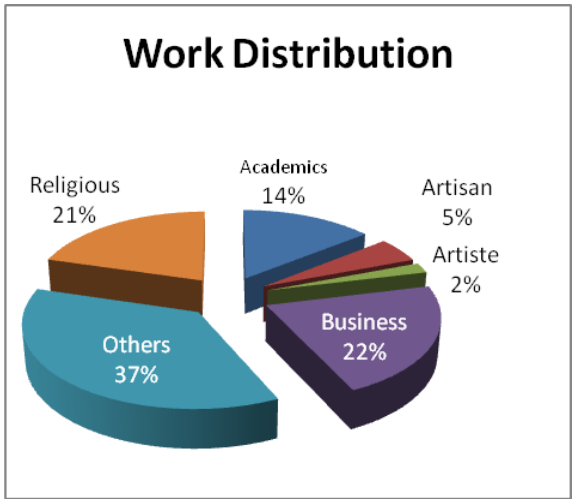

Fig 6: Employment Distribution

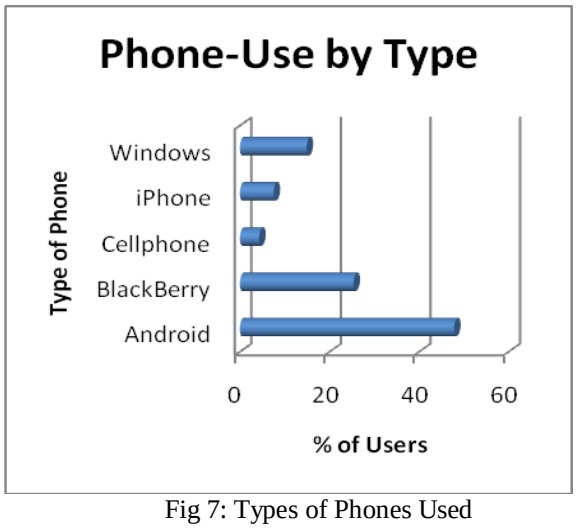

Fig 7: Types of Phones Used

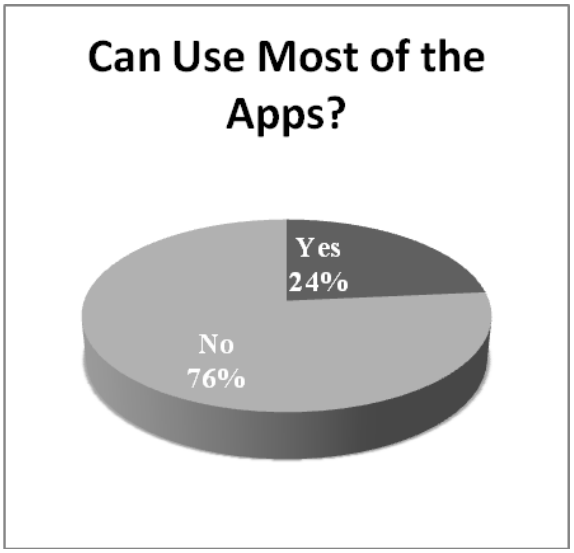

Figure 8: Ability to Use most Apps

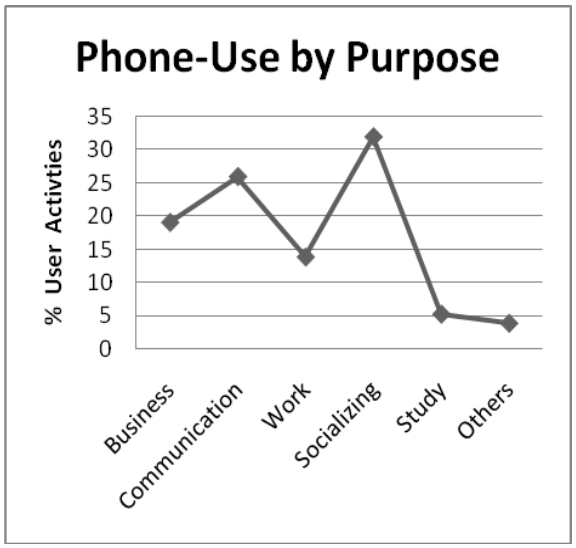

Figure 9: Purposes of Using Phones

B. Testing of Hypotheses

In the presentation of hypotheses tested, the following labels are used: SD for Standard Deviation; SE for Standard Error, N for Number of observations/respondents; df for Degree of Freedom, t-cal for the test statistics (calculated value) and t-crit for the critical value at 0.05 level of significance.

From Table III, the t-cal (1.54) is lower than the t-crit (1.96) at 95% confidence interval, hence the study accepts $\mathbf{H_{01}}$, and concludes that there is no significant difference in the means and standard deviations of phone's features and their usability among the respondents.

TABLE III: TESTING OF H_{01}

	Mean	Variance	SD	SE	N	df	t-cal	t-crit
Features	1.69	1.21	1.10	0.06	325	648	1.54	1.96
Usability	1.56	1.07	1.03		325			

TABLE IV: TESTING OF H_{02}

Gender	Mean	Variance	SD	SE	N	df	t-cal	t-crit
Male	3.43	0.46	0.68	0.03	475	648	-5.14	1.96
Female	3.11	0.65	0.81	0.06	175			

Table IV shows that the t-cal (-5.14) is lower than the t-crit (1.96) at 95% confidence interval, therefore, the study accepts $\mathbf{H_{02}}$, and concludes that there is no significant difference in the means and standard deviations of phone's features usability between the male and female respondents.

In Table V, it is shown that the t-cal (4.52) is greater than the t-crit (1.96) at 95% confidence interval. This implies that the study rejects $\mathbf{H_{03}}$, and concludes that there is a significant difference in the means and standard deviations of phone's features usability between employed and unemployed Nigerians.

TABLE V: TESTING OF H_{03}

Social/Employment Status	Mean	Variance	SD	SE	N	df	t-cal	t-crit
Employed	3.42	0.49	0.70	0.03	500		4.52	1.96
Unemployed	3.11	0.60	0.77	0.06	150	648		

TABLE VI: TESTING OF H_{04}

Educational	Mean	Variance	SD	SE	N	df	t-cal	t-crit
Students	2.20	1.58	1.26	0.12	112	648	-6.42	1.96
Graduates	1.51	0.97	0.97	0.04	538			

The t-cal (-6.42) in Table VI is smaller than the t-crit (1.96) at 95% confidence interval, hence, the study accepts the $\mathbf{H_{04}}$, and concludes that there is no significant difference in the means and standard deviations of phone's features usability between graduates and undergraduate members of the respondents.

TABLE VII: TESTING OF H_{05}

Age Category	Mean	Variance	SD	SE	N	df	t-cal	t-crit
Youths	1.44	1.22	1.10	0.06	337	648	5.03	1.96
Adults	1.87	1.15	1.07	0.06	313			

The testing of the 5th hypothesis captured in Table VII shows that the t-cal (5.03) is greater than the t-crit (1.96) at 95% confidence interval. The study rejects $\mathbf{H_{05}}$, and concludes that there is a significant difference in the means and standard deviations of phone's features usability between young and adult respondents.

C. *Discussion*

Out of the 650 respondents considered for this study, 73% were males while 27% were females as depicted in Fig 2. This shows that more males participated in the survey adopted in the study than the females. The age distribution captured in Fig 3, shows that 14% of the respondents were above 40years, 32% were between 31- 40, while 54% were between 18 – 30 years of age. This reveals that more youths were reached with the instruments for the study. Meanwhile, respondents from 31years and above were classified as adults as shown in Table VII. The educational status of respondents as presented in Fig 4 shows that 83% were graduates of various tertiary institutions while 17% were undergraduate students, implying that more graduates participated in the study than non-graduates. Fig 5 presents the employment status of respondents in three categories and the results from the analysis show that 23% were unemployed, 23% self-employed and 54% employed. The self-employed respondents were involved in various occupations like artisan, artiste, fashion, business and other endeavours as depicted in Fig 6. The employed category was actively seen in the academics, and religious circles, corporate world, manufacturing, etc. The unemployed class was the category of students and fresh graduates.

Fig 7 shows the type of mobile devices owned by the respondents and from the figure, 48% of the respondents owned Android phones, 25% owned Blackberry, 15% owned Windows Phones, 8% owned iPhones and 4% owned cell Phones. It is obvious from the analysis that most Nigerians possess Android smart phones. This brand of phone is increasingly penetrating the market while the regular handset/cell phones are gradually being phased out. Meanwhile, regular handsets are still very common in the hands of the less-privileged.

The analysis presented in Fig 8 measures the ability of the respondents to use most of the build-in utilities of their respective smart devices. 76% affirmed that their mobile devices were too advanced for them and as such could not understand most of the features nor use utility apps. Only 24% agreed they could effectively use most of the functions. This shows expressly that most Nigerians do not fully harness the resources embedded on their mobile devices. Fig 9 reveals by percentage what characterized the use of smart devices by the respondents. These are: socializing (32%), basic communication (26%), business (19%), work (14%), study (5%) and other activities, including news, (4%). This analysis reveals that the activities most Nigerians would do with the mobile devices are in the neighbourhood of social hobnobbing and basic communication.

In testing the five hypotheses formulated for this study, the first hypothesis was focussed on measuring the relationship between the features embedded in the smart devices used by the respondents, using the features and utilization theories. Given 325 observations for each attribute, the means and standard deviations are as follows: 1.69, 1.56 and 1.10, 1.03 for features and usability respectively (see Table III). The test accepts the H_{01} and concludes that there is no significant difference in the means and standard deviations of phone's features and their usability among Nigerians. However, it is important to observe that, though, Nigerians have the 'ability' to use the features of the phones but do not fully utilize those features. This is further substantiated in Fig 8, where the understanding and usage of most of the utilities were measured among respondents, showing that there is a wide gap between the features of phones and their utilization among Nigerians. This means that Nigerians score high in usability but poorly in resource utilization.

The second hypothesis was aimed at assessing the understanding of the features and the usability of most of the apps' utility across the two gender categories of respondents. Table IV shows the acceptance of H_{02}, and concludes that there is no significant difference in the means (3.43, 3.11) and standard deviations (0.68, 0.81) of phone's features usability by male (475) and female (175) respondents respectively. This implies that, there is not a statistical difference in the ability of male or female as regards using the advanced functions on their smart device. Table V presents the testing results of the third hypothesis, which sought to measure the understanding in terms of using the

inbuilt features of their phones with respect to social-employment status of the respondents. The study shows the rejection of the H_{03}, and concludes that there is a significant difference in the means (3.42, 3.11) and standard deviations (0.70, 0.77) of phone's features usability between employed (500) and unemployed (150) Nigerians considered in this work. This proves that the level of usage of smart features of mobile phones does depend on the social-employment status of Nigerians.

Testing the fourth hypothesis, Table VI shows the acceptance of the H_{04}, and concludes that there is no significant difference in the means (2.20, 1.51) and standard deviations (1.26, 0.97) of phone's features usability between undergraduate (112) and graduate (538) respondents. This means that the educational status of Nigerians does not sufficiently affect their ability to use sophisticated mobile devices. Although the levels of education considered by the study was the post-secondary education, where respondents are expected to have been familiar with problem-solving applications of most phone functions. The aim of the fifth hypothesis was to measure phone features usability with age brackets of respondents. In Table VII, there was a rejection of the null hypothesis, signifying that there is a significant difference between phone's features usability and age.

V. CONCLUSION

The analyses and hypotheses tested in the study have shown clearly the usability and resource utilization behaviours of Nigerians towards smart devices. Notably, the study has revealed that a rapidly growing population of Nigerians possess smartphones with various brands such as android, blackberry, windows and iphone. These mobile devices are loaded with smart tools for communication, navigation, context-awareness, situation-awareness, human-computer interaction features through haptic sensors, multimedia enablement, healthcare facilities, electronic business, social hobnobbing, etc. The study has substantiated that Nigerians do not have significant mobile devices usability problems but are obviously not harnessing the features embedded on these devices. It has also been shown that the ability to use mobile phones does not depend on gender or educational status but may depend on age and social-employment status of individuals. The study upholds that smart devices are grossly underutilized by the study population.

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