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INFORMATION AND COMM NICATION TECHNOLOGY (ICT) FOR DEVELOPMENT – THE EXIGENT AND FOUNDATIONAL APPROACHES FOR NIGERIA

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ABSTRACT
Having identified ICT production as the component of the ICT revolution that can enhance true socio-economic development to developing countries like Nigeria. This paper provides a way to achieving this by closely examining what ICT production entails and positioned that since ICT production is closely related to science, engineering/ technology, a more meaningful policy implementation in the area of technological growth and Science & Technology education is desirable. The paper is aimed at suggesting the redesigning of the Universal Basic Education (UBE) policy to inculcate ICT production knowledge into Nigerian child from the primary school level if our dream of ICT for development be fulfilled.

KEYWORDS: ICT production, ICT consumption, ICT production culture, Pseudo-ICT, ICT infrastructure, Policy implementation.

PREAMBLE

Following the rate at which ICT had contributed and still contributing to economic development of developed countries, many especially developing countries are adopting ICT components into many aspects of their developmental strategies with the hope that one day they will attain what the advanced countries have achieved. This perhaps informed the birth of National Information Technology Development Agency (NITDA) in Nigeria on the 18th of April, 2001 and the agency's headquarters was officially commissioned on the 4th of June, 2002 by the then senate president Anyim Pius Anyim.

According to Ajayi (2004), the goals of NITDA in part include:

- To ensure that ICT resources are readily available to promote efficient national development.
- To guarantee that the country benefits maximally and contribute meaningfully by providing global solution to the challenges of information age.
- To empower Nigerian to participate in software and ICT development
- To encourage massive local and global ICT acquisition through training in the public and private sectors with the view to achieving a strategic medium term milestone of at least 500,000 ICT skilled personnel by the year 2004.

However, many will continue to wonder around many options/strategies until another revolution emerges, for lack of a good staring point that is partly visible in the above NITDA goals which inclined more to ICT consumption than ICT production that has direct correlation with overall national development.

Development is the improvement in general well-being of a society. According to the United Nations (UN), all countries especially the developing countries must achieve an eight point agenda called the "Millennium Development Goals (MDGs)" by 2015 C.E. (Ndukwe, *et al* 2006), which includes eradication of extreme poverty and hunger, and achievement of "Universal Basic Education (UBE)". The focus of this paper is to channel a way for Nigeria and developing countries in general and demonstrate that both the exigent and foundational approaches are necessary for faster development but the foundational approach is paramount for long term, scientific and effective development of the country.

Furthermore, it shows that the first millennium development goal (eradication of extreme poverty and hunger) could be achieved using the second goal – UBE.

Technology is the systematic knowledge of a device and its application to industrial process (McGraw-Hill, 2002). Furthermore, ICT is the field of engineering involving computer-based hardware and software systems, communication systems, to enable the acquisition, representation, storage, transmission, and use of information (McGraw-Hill, 2002). The second edition of the Cambridge Encyclopedia (1990) says that information technology is "a term commonly used to cover the range of technologies relevant to the transfer of information in particular to computers, digital electronics, and telecommunications." Closely related is the definition offer by McGraw-Hill Dictionary of scientific and technical terms which says "information technology is the collection of technologies that deal specifically with processing, storing and communication of information, including all types of computer and communication systems as well as reprographic methodologies."

ICT is broadly divided into two components namely: ICT production and ICT consumption. And according to Al-Saadi, 2006 ICT production is the creation of hardware and software components of ICT, provision of ICT infrastructure, ICT consultants and trainers, web designers, internet service providers (ISPs) and data service providers (DSPs), while ICT consumption is the use of ICT amenities in applications like e-learning, e-medical, e-commerce, e-government, et cetera. From the foregoing, it is seen that the various definition of ICT is actually referring to ICT production which also have their foundation in engineering technology especially electronic and communication engineering, and since most of the ICT devices are software driven, it also indicate that computer science also plays a pivotal role in ICT production.

INTRODUCTION

Information and communication technology (ICT) has been identified as a revolutionary tool that can enhance multifaceted development of a nation (Ndukwe *et al*, 2006). This assertion was corroborated by Al-Saadi (2006) but argued that since ICT is visibly dividable into two components namely: ICT consumption and ICT production, it is the ICT production that is capable of engendering true socio-economic development especially to developing counties while ICT consumption is capable of further plunging them into dependency. More so, since engineering is the science by which the properties of matter and the source of power in nature are made useful to human being (Lapedes, 1978), while technology is the systematic knowledge of a device and its application to industrial process, ICT production can only be developed through development of engineering and technology which inversely enhances the societal well being. This is in accord with the aspiration of the international community as related by Tatsuya (2007) "International community has a consensus to encourage ICT development in developing countries based on the idea to stem the 'digital divide'. Especially, after the Kyushu-Okinawa summit which was held in 2000, the issue of 'digital divide' is widely recognized by the aid-providing community, and each donor has started to form ICT support projects towards developing countries". However, from the point of view of the goals of NITDA and the operations of the aid-providing community, the issue of ICT for development as not been viewed from the wider and multiply approaches perspective of making it as part of our culture for long term development on one hand and an urgent ICT development plan for us to quickly meet-up on the other hand, which are the focus of this paper.

EVOLUTION OF COMPUTER MACHINE

It is an axiom that ICT is a child of Engineering Technology. Looking at the growth rate of ICT and its contributions to development especially in the developed countries, and noting that the growth is pivoted mainly on advances in electronic and telecommunication fields, it is crystal clear that further development in electronic and telecommunication will enhance proportional expansion of the field of ICT with its accompanying development.

The invention of electronic thermionic diode valve in 1904 was a ray of hope to the possibility of telecommunication. Further research to enhance better performance of this device gave rise to more complex electronic themionic valves namely triode, tetrode, pentode, etc. This development greatly improved the lots of telecommunication and electronics which gave birth to the first generation computers. Telecommunication devices and computers employing the use of these electronic valves are relatively slow in operation (about 5,000 calculations per second), inaccurate in performance and consumes lots of electric power (about 150 kilowatts), with much heat being generated (Hellmut, 1988). Specifically speaking, first generation computers contained about 18,000 electronic, and the thermionic values connected together to perform some switching operations/function and needed to be water cool (Boylestad, 1987).

Owing to the aforementioned disadvantages associated with the electronic thermionic valves, further research by electronic scientists culminated in the discovery of semiconductor which up till date is yet to be e
qualed in production/fabrication of electronic diodes, transistors and integrated circuits (I.Cs.). Of particular reference is the transistor that came to replace and displace electronic thermionic valves in most application. The discovery of electronic transistor in the mid 1960s brought alongside with itself the evolution of better, in many respect, telecommunication equipments and the second-generation computers. The third and fourth generation computers were ushered in with the invention of large scale and very large scale integrated circuits in the 1970s, and 1980s, respectively. The fabrication of a whole CPU on a chip marked a great turn in the development and deployment of portable ICT devices. The CPU on a chip is popularly known as microprocessors. The first commercially available microprocessor was the Intel 4004, produced in 1971 (Douglas, 2006).

OVERVIEW OF INFORMATION TECHNOLOGY FACILITIES

A terminology in use today to collectively describe information technology equipment is the Value Added Network Services (VANS). The terms coined as a result of improvements introduced by the ICT equipments to the already existing facilities, for example telephone. VANS are market driven services, which are operated, in the same capabilities of existing Public Switched Telephone Network (PSTN) or Public Switched Data Network (PSDN) infrastructures. VANS comprise of fax (facsimile), voice–mail, e-mail, cellular telephone, paging, teletext, and audio teleconferencing. Others include video teleconferencing, video text, electronic data interface electronic fund transfer, intranet and internet. The figure below shows in summary the development in ICT till date.

The implication of figure 1 is that while it graphically summarizes the ICT revolution, it pointed to the future indicating that ICT era is still far from its moribund points; hence an opportunity for developing countries likes Nigeria to participate. However, the difficult aspect is to know where to start from, while it may be tempting to ‘jump’ into it and move along to compensate for lost time and avoid perpetual lagging, it is instructional to understand the basis of ICT before going into it for it will ensure effective participation and ability to discover or invent. Therefore, the approach in this paper is that since Nigeria is blessed with human and material resources, the two approaches could be adopted by encouraging already established Nigeria researchers to ‘jump’ onto it, and then go back to the nation educational policy which has been describe as inadequate (Sule-Kano & Edeh, 2007) and the technology policy and reposition then to incorporate other useful things and reflect ICT fundamentals.

THE EXIGENT APPROACH

The first approach called the exigent approach is achievable by strong technological partnership with the ICT developed countries to ensure the training of Nigerian engineers and ICT related researchers specifically in ICT production, and provide ICT infrastructure in the country to guarantee conducive atmosphere for ICT development on completion or return to the country. For the purpose of this option, Nigerian researchers may go into the following areas currently going on in ICT research laboratories. These include; opto electronics, nano electronics, artificial intelligence, fuzzy set and fuzzy logic, wavelet analysis, terahertz, terabyte, neural network, biomimetics, image processing, multi-level programming, and many more.

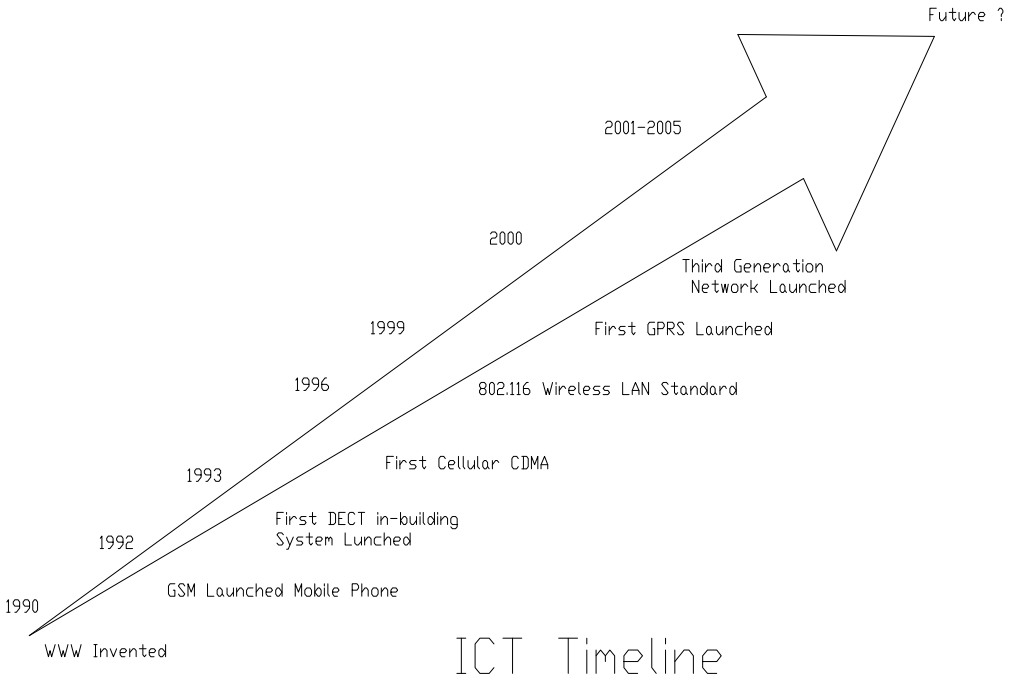

FIGURE 1: ICT TIMELINE

NEED FOR FOUNDATIONAL APPROACH

The second alternative which is called the foundational approach is based on the fact that both the present achievement in ICT as can be seen in the ICT facilities and an evaluation of the ongoing researches in ICT as presented earlier brings into our awareness that a strong foundation in sciences especially mathematics and physics is essential in the future of ICT especially considering the fact that both engineering and computer science are sciences of numbers, symbols, and figures – mathematical (Hornby, 2000).

This approach is equally important because it also conforms to the law of first principle. The first principle in any field is its basis, and understanding the basis of an idea provides one with the necessary tool to manipulate it to taste. Hence mastering the basis of ICT will unfold the secret of ICT production better than it would have applying the exigent approach. Equally and more closely related is that the first principle in education is the primary level, using the platform of the Universal Basic Education (UBE) which is the second point in the UN millennium goal, and which had been adopted by the Nigeria government as contained in the National Policy on Education (Federal Republic of Nigeria, 2004), thus we are left with inculcating ICT production culture rather than ICT consumption culture into the Nigerian children by recasting the way(s) ICT production related subjects are planned and taught in both primary and post primary levels of education and looking into the admission policies in Universities to examine the percentage of science and technology graduates produced in relation to other discipline. As a justification for having to recast the teaching of mathematics and sciences, the work of Jiboyewa (2007) as given in tables 1 and 2 is instructive.

TABLE 1: WAEC 2004 PERCENTAGE OF STUDENTS PASSING BY SUBJECT ACCORDING TO SCHOOL ZONE IN ADAMAWA STATE.

S/N		ANS	English %	Mathematics %	Sciences %
1	Mubi	380	3.5	4.0	13
2	Gombi	530	4.2	1.4	19
3	Numan	815	18	28	30
4	Ganye	877	4.2	10	20
5	Yola	742	5	38	16
6	State Mean		6.98	16.28	19.6
7	Standard Deviation (SD)		6.1	15.97	6.42

ANS = Average number of students sitting for examination in the zones based on sample

TABLE 2: WAEC 2005 PERCENTAGE OF STUDENTS PASSING BY SUBJECT ACCORDING TO SCHOOL ZONE IN ADAMAWA STATE.

S/N	School Zones	ANS	English%	Mathematics%
1	Murdi	631	6.0	26
2	Gombi	709	14	35
3	Numan	1060	26	68
4	Ganye	1259	2	34
5	Yola	340	19	50
6	State mean		13.4	42.6
7	Standard deviation(SD)		9.6	16.13

Jiboyewa further asserted that the picture painted of Adamawa State as contained in the tables above is equally true of the North Eastern Nigeria and may not be far from the situation in other parts of the country with respect to students' performance in mathematics and other science according to Ezekwesili (2006) and for Africa as related by Kyari (2006). The implication of this for ICT production is that very few graduates from the secondary schools have the requirement to pursue ICT production related disciplines and this was the situation about a decade ago when Limbo (2002) lamented that large percentage of University graduates are from the arts and social sciences (ICT consumers). His research is presented in table 3.

All these constitute the need for recasting the planning and teaching mathematics and sciences plus others related problems to actualize ICT production dream.

THE FOUNDATIONAL APPROACH

With the planned implementation of the UBE and enrolment figure of 70.6% in Nigeria (Dangler, 2006), the structure of our education changed from the 6-3-3-4 to 9-3-4 hence this paper will present necessary recast that will entrench ICT production culture at the first two strata of the UBE structure and that constitute the foundational approach. The foundational approach is based on the examination of the syllabi, teaching materials, and teaching method of the aforementioned subjects and was observed that it is deficient in applying the principle of Scientific Method which according to (Grogan, 1976) is pictured in the block diagram of figure 2.

With respect to ability to participate in ICT production we must emphasize observation and contemplation from early level of our education and the application of these instrument to the needs of our natural and pseudo-natural environments, think and proffer solutions to them as challenged by (Uche, 2006) or apply ICT facilities to solve them. As regards inculcating ICT production fundamentals into primary and post-primary syllabi, it is better we identify what are ICT production fundamentals.

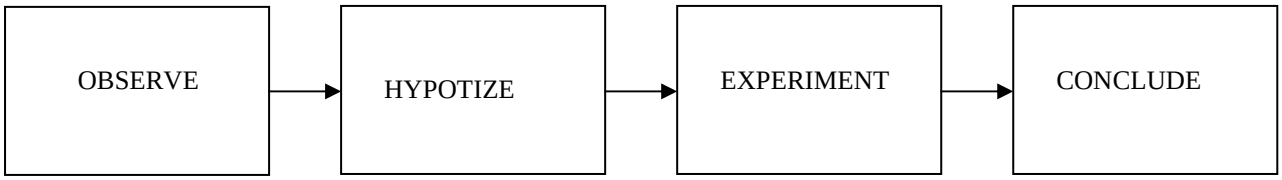

FIGURE 2: BLOCK DIAGRAM OF SCIENTIFIC METHOD

TABLE 3: GRADUATE OUTPUT BY DISCIPLINE

YEAR/ DISCIPLINE	1993	1994	1995	1996	1997
Administration	1483	-	1440	560	328
Agriculture	1846	-	161	391	186
Arts	5818	-	2800	1431	637
Education	8962	-	3661	1668	591
Engineering/ Technology	2425	-	1184	900	843
Environmental/ Design	736	-	422	372	171
Law	867	-	248	522	142
Medicine	1422	-	459	282	562
Pharmacy	353	-	49	52	-
Sciences	5271	-	2917	1300	692
Social Sciences	5243	-	3246	1360	1433
Vet. Medicine	151	-	19	28	-
Total	34577	-	17059	8867	5325

*Many Universities could not graduate students in 1994

ICT PRODUCTION (ICTp) FUNDAMENTALS

The primary and secondary levels under the UBE strata can visibly be divided into three namely: primary, senior primary, and secondary. At each of these levels some ICT production fundamentals will be injected into the mathematics and sciences subjects that will implant the needed ICT production culture into the Nigerian pupils and students.

For the purpose of this paper, the ICT production fundamentals are thought of as those sub-branches of knowledge that forms the bases of ICT production. From Al-Saadi's and dictionary's description of ICT production as cited above, and the aspect of observation as a part of scientific method also stated above, one may conclude that ICT production fundamentals as applied to primary and secondary levels of education are: logical reasoning, computer appreciation, observation, programming fundamentals, experimentation, Boolean Algebra, logic circuit, and application of programming in solution to examples in physical sciences. All these could be embedded in the ICT production related subjects such as mathematics and physics. However, it should be noted that the fourth edition of the Nigerian National Policy on Education lists computer education as one of the subjects at the primary school level (Federal Republic of Nigeria, 2004), from casual observation only few public schools have the human and material resources to actualize this while most private schools partially and uncoordinatedly (Oguntoye, 1996) features it. Furthermore, even when properly implemented it could only be best describe as Quasi ICT education, because the computer education syllabus will still fall short of two things viz.: insufficiency, for the reason that computer is though a major part of ICT but not the totality of ICT and secondly, the syllabus is only

seeking to teach the use of computer which tilt more towards ICT consumption than ICT production. In the UBE arrangement, the primary is nine (9) years which for the purpose of this paper have been broken down to primary of six (6) years and senior primary schools of three (3) years.

THE PRIMARY LEVEL

In order to implant ICT production culture at this stage of learning, pupils should be taught the basis logical reasoning as from the fourth year, in the fifth and sixth year computer studies should be introduced with emphasis on practical. The basis of logical reasoning could be studied under arithmetic or mathematics while computer studies could be taught under computer education.

THE SENIOR PRIMARY LEVEL

At the senior primary level, the computer studies should continue with equal doses of practical and theory, and logical reasoning in a more elevated form. Also fundamentals of computer programming should be commenced and the first stage of scientific method – observation – be introduced. It is also important to create awareness in the students of the relationship between logical reasoning and computer hardware & software. For ease of dissemination, logical reasoning and programming fundamentals could be taught under mathematics; computer studies remains with computer education; and observation as the first stage of 'scientific method' under sciences.

THE SECONDARY LEVEL

The work of the early level should be consolidated upon by increasing the programming activities of the students. A simple structured program could be taught with programming examples drawn from the solutions to examples in mathematics and sciences. Likewise, at this stage more cognitive observation should be taught and since students will be exposed to experimentation at this stage, the link between observation and experimentation should be drawn. Furthermore, Boolean algebra and logic circuit should be taught, and they should be shown how programs are implemented using he logic circuit. Observation and experimentation will come under science, while Boolean algebra, logic circuit, and programming is taught in mathematics. Lastly, textbooks, especially mathematics and sciences textbooks should where possible, use a simple programming language to solve example problems in addition to the usual method.

CONCLUSION

National development means development of both human and environmental components of a nation. This is an implicit statement encompassing development of all sectors of human endeavour. From what has been mentioned in this paper, it is evident that ICT production is the component of ICT that is capable of bringing about national development if strictly pursued by making it to be part of our culture through the early educational strata as suggested in this paper. In fact, it was ICT production and not ICT consumption that developed and is still developing the industrially developed countries. Furthermore, since ICT has the capability to enhance other areas of endeavour, hence national development would be possible if Nigeria could play an active role in the manufacturing and application of ICT facilities.

However, as said by Professor Shaozhi. Su of Chinese Academy of Social Sciences that, information technology is both an opportunity and a threat especially to developing countries (Hellmut, 1988) like ours, we must acknowledge that we are bound to have problems particularly that of continuous backwardness with respect to the developed countries if the exigent approach is forsaken. However, adopting the two approaches simultaneously will produce the best result which includes:

(a) Updating the intellectual capacity of our indigenous ICT researchers and professionals.
(b) It will quicken Nigeria's participation in ICT production.
(c) It will enhance Nigeria's contribution in scientific discoveries and other uses of ICT.
(d) Safe huge amount of money from going out while enabling exportation of ICT facilities.

RECOMMENDATIONS

(a) Simultaneous and quick implementation of both approaches.
(b)Effective implementation of the UBE program incorporating the proposal in this paper.
(c) Creating a center for ICT development in each of the six geo-political zones of the country.
(d) Creation of ICT infrastructure to enhance ICT development in Nigeria.
(e) Strengthening ICT related disciplines in our tertiary institutions to be able to produce qualified ICT professionals.

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