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Comparing Information Technology Curriculum in Nigeria and U.S.A. Tertiary Institutions

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Abstract

There is a growing awareness of the importance of Information Technology in achieving the goals as set out in Millennium Development Goals (MDG). The constant changes in knowledge and skills required for effective application of Information Technology makes it imperative for tertiary institutions in developing countries to prepare skilled manpower to meet the necessary challenges. This study examines the information technology curriculum in Nigeria, and compares it with that of the United States of America. The results allow us to determine the competitiveness of Nigerian graduates in the global market.

INTRODUCTION

There is a growing awareness of the importance of Information Technology in achieving the goals as set out in Millennium Development Goals (MDG). Information Technology improves the delivery of basic services and enhances local development opportunities. The constant changes in knowledge and skills required for effective application of Information Technology make it imperative for tertiary institutions in developing countries to prepare skill manpower to meet the challenges. This is the motivation for this study that compares IT curriculum in a developing nation with the IT curriculum in U.S.A. so as to produce Information Technology human resources with skills for sustainable development.

Millennium Development Goals, Sustainable Development and IT
At the United Nations Millennium Summit in September 2000, world leaders meeting in New York placed development at the heart of the global agenda. The Millennium Development Goals (MDG) agenda adopted, with 18 Targets, was:

- Eradication of extreme poverty and hunger
- Achieving universal primary education
- Promoting gender equality and empower women
- Reducing child mortality
- Improving maternal health
- Combating HIV/AIDS, malaria and other diseases
- Ensuring environmental sustainability
- Developing a Global Partnership for Development

The eight goals form an ambitious agenda to improve the condition of human beings by 2015. Let us now examine how applications of IT had been used, and being used, to achieve the set targets and goals.

Poverty and IT
Schumacher (1973) shows that poverty relates primary to limited access of the poor to knowledge and resources for their basic human needs and promote sustainable development. The UNDP Human Development Report 2001 concludes that Information Technology can make an important development impact and overcome barriers of social, economic and geographical isolation, and increase access to information and education. The UNDP reports extensive applications of Information Technology in eradication of poverty in India, through the provisions of database of relevant information. Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). Skill manpower in IT is needed for the future generation to meet its needs for sustainable development by 2015, as set by the MDG.

Education and IT
Millennium Development Goals state that all children must complete a full course of primary education. The melting of computer technology with universal primary education had made impact on children in South Korea, where a program to revitalize schools and help children learn about Information Technology was launched in 1953 (Gryc, 2003). "The use of Information Technology is the "reality" that faces students upon graduation."(NSSE, 1996). The role of IT in education cannot be overemphasized, and knowledge is critical for development.

Gender and Equality
World Bank uses practitioners, policy makers and academics to discuss the impact of ICT on gender relations and how ICT can be used to overcome gender inequalities (World Bank Group, 2004) Usha Sharma writes that Information Technologies are powerful tools for women to use to overcome discrimination, and achieve full equality (Sharma, 2003).

Child Mortality, Improved Maternal Health, Combating HIV/AIDS and IT
United Nations Information Technology Service uses IT facilities to monitor UN interventions, provide feedback to a databank and report on disease surveillance. (http://www.un.org.in). The Economic Commission for Africa states that the health sector is the most information intensive sector and that all dimensions of health are now supported by IT applications (ECA, 1999).

Environment and IT
Sustainable development requires intelligent environmental decisions that can be made with the help of timely, relevant, and reliable information using IT The Federal Government of Nigeria, recognizing the importance of IT has embarked on programs to strengthen institutions and human resources development, in the area of Information Technology (CSD, 2002). Information Technology is helping in achieving sustainable development by providing well-developed and useful tools for decision makers (Kersten, *et al.* 1999).

IT National Policy
In Nigeria, a National IT Policy wants to make Nigeria an "IT capable country in Africa by the year 2005, using IT as engine for sustainable development and global competitiveness" (NITDA, 2001). Human resources development is one of the sectorial applications receiving attention among the policy objectives and strategies. The National Policy believes it will position Nigeria as an IT capable country in Africa, to respond to the challenges of IT globalization in goods, services and human capital. The goal of the IT policy is to have 500,000 IT professionals by the end of 2004. The policy has several general objectives that relate to human resources development. by developing for tertiary institutions, relevant IT curriculum.

NIGERIAN HIGHER EDUCATION SYSTEM AND IT CURRICULUM

In 2003 there were about 50 degree awarding universities in Nigeria (JAMB, 2003). Nigeria has over 50 percent of Africa's total number of universities and student enrolment (Bako, 2002). There are both public and private higher institutions. Public universities are owned by the federal and state universities, while the private universities are owned by private concerns.

Formal education as a means of creating skill is the most reliable indicators of IT development capacity of a nation. IT professionals are expected to be produced through the process of education, training, experience and continuing education. An important component of IT education in Nigeria is the Industrial Work Experience Scheme (SIWES), similar to the internship program in universities in USA.

Information Technology Education
In U.S.A., there are programs in Computer Science, Management Information Systems, Computer Engineering, Information Systems, Computer Information systems. Recently a number of universities started bachelor degree programs in Information Technology (Denning, 2001). Skill areas produced by programs of Information Technology match expectations of Information Systems faculty and the courses of Information Technology are acceptable to both Information Systems and Information Technology faculties. It is agreed that, "there is no significant difference between (IT) degree and degrees in Computer Science and Information Systems" (Reichgelt, *et al*. 2003). Information Technology is "an academic discipline (that) focuses on meeting the needs of users in an organizational and societal context through the selection, creation, application, integration and administration of computing technologies" (Reichgelt *et al*. 2003*)*. Information Technology is also described as "the body of knowledge encompassing theory, principles, techniques, practice and skills spanning such disciplines as Computer Science, Computer Engineering, Information Systems, Software Engineering, Information Technology and other related disciplines" (Uwadia, 2003).

In Nigeria, there is a unified curriculum designed by National University Commission (NUC) that sets the minimum academic standards. Courses are based on credit hours, and semester hours are widely used as a measure of course load as it is done in U.S.A. There is no professional organization that provides input into the development of IT curriculum. The NUC uses the expertise of university administrators and faculties to constitute program accreditation committee that visits universities.

In U.S.A., the first curriculum models were introduced in the early 1970s (Gorgone, et al. 2003). The task of developing IT curriculum in USA began during the 1970s with Association of

Computing Machinery (ACM) been a major organizer. Other organizations that helped with the development of IT curriculum are AIS (Association for Information Systems), AITP (Association of Information Technology Professionals) (formerly DPMA) and IFIP (International Federation for Information Processing).

There are four major areas of IT that must be integrated into IT curriculum for the professionals to have broad business perspective, have strong analytical and critical thinking skills, exhibit strong ethical principles with good interpersonal communication and team skills, and to design and implement IT solutions that enhance organizational performance. The IT professionals must have broad responsibility to plan, develop, implement and manage computers, communication facilities, data and enterprise information processing systems. They must be able to incorporate various concepts while creating and implementing systems in the organizations. They must also have sound technical knowledge of hardware, software and communications, and be familiar with organizations and its various functions. The degree program must include "Information Technology, information systems management, information systems development and implementation, organizational functions, and concepts and processes of organizational management" (Gorgone, *et al.* 2003). The exit characteristics of an IT program must support a central role for technology-enabled business development with four major areas of Business Fundamentals, Analytical and Critical Thinking, Technology and Interpersonal, Communication and Team Skill.

We select two universities, University of Lagos, Nigeria and Morgan State University, Baltimore, Maryland, U.S.A. for comparison.

University of Lagos, Nigeria was the first higher institution that started courses in computer-related disciplines in Nigeria. The Department of Computer Science emerged in 1973 out of the Institute of Computer Sciences. Lagos is the commercial and financial nerve centre of the country. About 80 per cent of IT professionals in Nigeria work in Lagos. The course of study lasts four years and the actual course of study for a degree tapers towards specialization in the final year in one of three areas of Computational Analysis, Information Technology and Software Engineering (Unilag, 2004). Few graduates select the Computational Analysis option and all students in Information Technology option are likely to select the compulsory courses for Software Engineering as their electives.

Morgan State University, Baltimore, U.S.A., a typical higher institution, is suitable for comparison. The Department of Information Science and Systems is in The Earl G. Graves School of Business and Management. The main objective of the department is to provide opportunities for students to study and apply various technical and organizational aspects of Information Technology. The program enables the students to develop a solid foundation in key information systems and in organizational and business skills.

We adopted the classification of courses offered for degree of Information Technology as reported by Lunt *et al.* (2002). The categories are: Business related courses; Courses concentrating on interpersonal communication; Software related courses; Courses on networking, web-related technologies or databases; Electronics and signals; Hardware; and Mathematics and Science.

Table 1 shows the broad categories and the courses offered by the universities.

Table 1:   Approved Categories and Courses Offered In Two Universities

Categories	University of Lagos	Morgan State
Business related courses	*Information Systems Management *Introduction to Systems Design and Analysis	*Principle of Account. I & II *Economics I & II *Bus. Leadership Seminar *Mgmt & Organ. Behavior *Principles of Marketing *Management Info Systems *Managerial Finance *Legal & Ethical Environment *Foundation of Intern. Business *E-Business *Business Policy
Courses on interpersonal communication	Use of English I & II, Introduction to Logic Industrial Training I & II	*Introduction to Logic *Humanities I & II *Business Communication *Special Topics & Internship
Software Courses	*Principles of Computer Science *Introduction to Computer Programming, *Foundation of Sequential Programming *Introduction to Information Processing *Concurrent Programming *Machine and Assembly Language *Introduction To Compiler Construction *A Modern Programming Language *Principles of Programming Language Software Requirements Specification and Analysis (**elective**) Software Design and Architecture Software Testing, Quality Assurance & Measurement (**elective**) *Operating System Software Engineering (**elective**) Compiler Construction (**elective**)	*Object-Oriented Application *Object-Oriented System Analysis & Design *System Development Project *Visual Basic *Client-Side Programming *Server-Side Programming *Advanced Java *Information Systems Dev.
Courses on Networking, Web-related technologies or databases	*Introduction to Database Management *Data Structures & Data Management *Data Communications *Computer Network	*Database Systems *Telecommunication & Network
Electronics and Signals	*Electronics 1A & 1B *Introduction to Theory of Computing	
Hardware	*System Performance Evaluation *Computer Architecture *Analysis and Design of Digital System	
Maths & Science	*Real Analysis I *Mathematical Methods I & II *Algorithms *Numerical Computation	*Production & Operations Mgmt *Analytical Decision Making

* These are compulsory courses

We breakdown the two programs by determining the number of courses required for each topic as shown in Table 2.

Table 2:   Breakdown of Courses by categories

Categories	University of Lagos	Morgan State University
Business Related	2	13
Interpersonal Comm.	5	6
Software	15	8
Network & Database	4	2
Electronics	2	0
Hardware	3	0
Math & Science	4	2

We use the content of IT 2002 curriculum, widely accepted in U.S.A. by all universities offering degrees in Information Technology to compare how each of the selected universities is satisfying the requirements of the curriculum. The IT Curriculum model of 2002 recommends ten courses for a program of degree in IT, with a prerequisite course. Table 3 shows the main five areas and the number of courses offered by each university to meet the recommendations

Table 3:   Curriculum Presentation Areas And Number of Courses Offered at Each University

Presentation Areas Required # of Courses)	University of Lagos	Morgan State University
Prerequisites- Productivity with IS (1)	0	1
Info Systems Fundamentals (2)	1	2
Info Systems Theory & Practice (1)	0	0
Information Technology (3)	2	2
Info Systems Development (4)	2	4
Info Sys Deploy & Mgmt Process (1)	0	1
Total 10	**5**	**10**

A discipline can be described by the skills that we expect the professionals to possess. We adopt the accreditation criteria of the Society for Information Technology Education as shown in Table 4. We examine these criteria against courses offered by each of the selected universities.

Table 4:   Skills and Capabilities for Information Technology Graduates

1. Use and apply current technical concepts and practices in the core information technologies, including human computer interaction, programming, computer networking and hardware, databases, web technologies and issues;
2. Analyze, identify and define the requirements that must be satisfied to address problems or opportunities faced by organizations or individuals.
3. Effectively design IT-based solutions and integrate them into the user environment taking into account user-centric design and interface, usability testing for effectiveness and efficiency, and the impact of the solution of the wider organization;
4. Create the effective project plan, including accurate estimates of the time, financial and other resources required for completion of the project and implement the plan, including the timely identification and implementation of appropriate measures to stay within schedules and budget constraints
5. Identify and evaluate current and emerging technologies and discuss their applicability to solve the user's needs;
6. Analyze the impact of technology on individuals, organizations and society, including ethical, legal policy issues

Source: Society for Information Technology Education, 2003

RESULTS AND FINDINGS

Using Lunt (2002) broad categories, we found that IT students in Nigeria study

- Fewer business related courses and no e-business course
- Many software courses that can be regarded as legacy systems related
- More theoretical courses such as "theory of computing"
- Hardware courses
- More quantitative courses

In USA, IT students study

- Many business related courses
- Courses on interpersonal communication
- "Modern" or "Current" programming languages
- Telecommunication, including Internet
- No course on "theory of computing"
- No course on Hardware
- Fewer quantitative courses

Considering the number of courses offered in each university, the Nigeria university requires that students take twenty-four IT courses (15 Software courses, 4 Database and Network Courses, 2 Electronic Courses and 2 Hardware courses), while the U.S.A. university requires ten IT courses (8 Software courses, and 2 Database and Network courses)

Using the recommendation of IT curriculum model of 2002, University of Lagos offers only five of the required ten courses, and does not offered any course on Productivity, Information Systems Theory and Practice, Information Systems Deployment and Project Management Process. Also it offers one instead of the required two courses for Information Systems Fundamentals and offers two instead of the required four courses for Information Systems Development.

While Morgan offers ten courses, even tough not completely the ten required courses in the model curriculum, the university does not offer any course on Information Systems Theory and Practice.

Considering the skill capabilities expected of an IT graduates as specified in Table 4, the Nigerian curriculum is deficient in the use and application of the current concepts and practices in the core technologies such as web technologies. The graduates are likely not to have studied any course that will expose them to issues relating to the World Wide Web. Problems faced by organizations and the possible solutions and its impact on organizations might not be appreciated by an IT graduate of Nigeria. The curriculum in Nigeria is not addressing Project Management skill. Lastly, the impacts of IT on individuals, society and organizations, including ethical and legal issues are not part of the curriculum in Nigeria.

Generally, in the curriculum being offered in Nigeria, there are many courses that can be considered "irrelevant" to IT discipline. There are greater emphases on courses which are more theoretical and business courses are not offered IT graduates, thereby not prepared to face the challenge of globalization. New ideas and concepts in programming, such as object-oriented programming are not available. Information Security, which is very important is not offered,

while Productivity courses such as Access and Excel which help in understanding Decision Support Systems in business and commerce are not available. E-commerce which is a driving force of globalization is not offered.

CONCLUSION

The main deficiencies in IT skills acquired in Nigeria are the total lack of business related courses. Curriculum should be dynamic and change with time. IT is a dynamic discipline; therefore the curriculum of the university should reflect this dynamism. In a developing nation like Nigeria, a periodic review of curriculum of IT education must be undertaken to bring them in line with modern trends. This will involve periodic accreditation of programs by accreditation agents. Professional bodies should be involved in the development of IT curriculum. "If an academic unit were providing graduates solely for local business and government, the input on program contents could be derived from representatives of local organization that hire the graduates. However, local employment is not the sole objective for undergraduate majors in Information Technology. Students from IT programs accept jobs in widely dispersed geographic areas. Therefore, the availability of curriculum models enables local academic units to maintain academic programs that are consistent both with regional and national employment needs and with the common body of knowledge of the IT field" (Gorgone, *et al*. 2003).

Sustainable development and the roles of IT make it imperative for graduates of developing nations' universities to be trained to a level that they can enable businesses use computers and communications to achieve their strategic objectives to provide the necessary services to the people and customers. Skills acquired to achieve these objectives will allow the IT professionals of a developing nation contribute to the sustainable development of the nation.

REFERENCES

Schumacher, E.F. (1973). Small Is Beautiful: A Study of Economics As If People Mattered, UNESCO, Paris. (http://www.un.org.in)

Gryc, W. (2003) Universal Primary Education and Computer Technology, *Panorama – ATakingITGlobal Online Publication*

National Study of School Evaluation (1996). *Technology: Indicators of Quality Information Technology Systems in K-12 Schools* (Project directed by K. Fitzpatrick and J. Pershing). Scaumburg, IL

World Bank Group, (2004). *Gender and Information and Communication Technologies*, (List of Seminars on Gender and ICT). Updated September 04, 2004

Sharma, U. (2003). *Women Empowerment through Information Technology*, Authorspress, Delhi, India

JAMB, (2003). *University Matriculation Brochure*, Joint Admissions and Matriculation Board, 2003/2004 Session, pp34

Bako, S.(2002). "Union, State and the Crisis of Higher Education", *Pape*r *Presented At the 10th Codesria General Assembly*, Kampala, Uganda

Economic Commission for Africa (ECA). (1999). Information And Communication Technology For Health Sector, *The African Development Forum*, Post ADF Summit, Addis Ababa, Ethiopia.

Commission on Sustainable Development (CSD).(2002). Country Profile 2002 Nigeria, Johannesburg Summit, UNCED, pp 65

Hoffman, K., M. Hobday (1990). "US Telecommunication Policy and The Third World: The Primacy of

Developmental Concern Over Pressures for Regulation, *Information Technology For Development*, Vol. 5, #3, Oxford University Press, New York.

The World Commission on Environment and Development, (1987). Our Common Future, Oxford University Press, 1987 pp.43

Kersten, E., Z. Mikolajuk, and A. G. Yam (1999). *Decision Support Systems for Sustainable Development – A Resource Book of Methods and Application*, IDRC/Kluver Academic, New York

Uwadia, C. O. (2003). "IT Education In Nigeria: Challenges and Opportunities", *Paper Presented At the Global NCS/NITPA IT Conference,* Washington, DC.

Denning, P. (2001). "The IT Schools Movement", *Communications of ACM*, 44 (8) 19-22.

Gorgone, J. T. (2003). "Guidelines for undergraduate Degree Programs in Information Systems", *The DATA BASE for Advanced in Information Systems,* Vol. 34, No. 1

Lunt, B., R. Helps, E. Lawson, and G. Goodman (2002). Designing an IT Curriculum: The results of the first CITC conference. *Proceedings of the 2002 American Society for Engineering Education Annual Conference* & Exposition.

Unilag (2004). *Prospectus of Faculty of Science, Department of Computer Science*, University of Lagos, Lagos, Nigeria