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Evaluating the implementation of international computing curricular in African universities: A design-reality gap approach

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ABSTRACT

Efforts are been made by Universities in developing countries to ensure that it's graduate are not left behind in the competitive global information society; thus have adopted international computing curricular for their computing degree programs. However, adopting these international curricula seem to be very challenging for developing countries having in mind that they were developed for developed rather than developing countries realities. In this paper, we use Heeks (2002) design-reality gap as an evaluative space for an international computing curricula assessment. We employed the OPTIMISM concepts of the design reality gap framework to focus on the match or mismatch of implementing such curricula in a developing country setting. We based our evaluation on the design and implementation of an international (British) computing degree programs in a private university in Nigeria. Our analysis shows that significant progress has been made, but that important gaps between design and reality exist, hence, challenges persist. The study concludes with some recommendations for policy makers advancing an agenda for "ICTs for Development" in the education sector.

Keywords: ICTs; Development; Education; University; Developing Countries; Nigeria; Design Reality

INTRODUCTION

Governments of developing countries have invested tremendously on ICT projects for socio-economic development. However, the developmental impacts of these investment is hard to pin point. The assessment of ICT for development (ICT4D) projects on development has been faced with limited focus and analysis in terms of sustainable development impact (Madon, 2004; Kamel et al., 2009). The few evaluation reports available have been criticized for lacking a strong methodological foundation, being descriptive and lacking rigor (Heeks, 2010). Hence, there is a need for a more theoretically focused approach to understanding the impact of ICT4D projects in developing countries (Heeks, 2010).The majority of the world's population resides in developing countries and are faced with inadequate access to resources such as education, water, health and electricity required for satisfying basic human needs. Furthermore, the majority of the people in developing countries are denied political liberty which has resulted in their lack of freedom to make choices in their own lives (Sen, 1999). According to Walsham et al. (2007), this situation presents moral circumstances in which all actors advancing an agenda in ICT4D need to be concerned with (Walsham et al., 2007).

In this study, we concentrate on human capacity building which Nissanke (2006) describe as the competency profile of knowledge, skills and attitude that indirectly links the relationship between ICTs and development. The notion of human capacity building using ICTs has been identified as vital to facilitating socio-economic development which in turn, is a significant pre-requisite for advancement towards the millennium development goals (Hakura & Nsouli, 2003). As such, the education sector in developing countries have adopted ICT as a tool for poverty alleviation and

capacity building, therefore contributing to the efforts of the country to meeting the millennium development goals. Today many universities in developing countries offer computing degree programs in order to produce ICT savvy workforce to drive socio-economic development (Rhee, 2009). However literature shows that the computing curricular founded in many developing countries are outdated thus producing graduates that lack the skills required by employers seeking to apply ICTs; hence damaging the link between ICT and human development (Bass & Heeks, 2008; Soriyan et al*., 2005*).

Yet little research has been produced with understanding the issues affecting computing curriculum in developing countries despite majority of them offering computer science as a degree program (Bass & Heeks, 2000). There is clearly a need therefore for more theory driven, responsive and rigorous research into the assessment of computer science curriculum in developing countries universities. This paper suggests a broader theoretical lens to unpack the multiplicity and complexity of ICT4D interventions in nations of developing countries. Specifically, we draw upon the Heeks (2002) design reality gap framework to evaluate the implementation of an international computing curricular in a developing country university. The contribution of this paper is to give some insight into the issues impeding the design and implementation of international computing curricula in universities of developing countries.

The rest of the paper is structured as follows. The following section provides literature review on the complex link between ICTs and development. This is followed by a section providing details of design reality gap framework and its key elements upon which the authors will apply to evaluate the implementation of an International computing curricular in a Nigerian university designed to produce ICT professionals that can compete both nationally and globally. The research method, research setting and the analysis of the case are then presented. The final section concludes the paper and recommendations for policy makers and stakeholders in the education sector.

LITERATURE REVIEW

ICTs and Development

Understanding the domain of ICT4D is incomplete without unravelling the term *"development"*. The notion of development within the ICT4D literature is a highly contested notion. According to Sein & Harindranath (2004), this debate has centered towards its meaning and can be classified within three discourses, that is, dependency, modernization, and human development. The dominant conceptualization of development since the Second World War draws upon the modernization theory of economic growth. According to these theory, deficiencies in knowledge partly results in under development. From these view point, development can only occur in developing countries if they follow the process of development adopted by developed countries. Following this approach to development, ICT is argued to be a tool for industrialization or an industry itself, with emphasis placed on how technology can enhance competitiveness, mechanization and productivity (Zheng, 2009).On the other hand, the dependency approach to development argues that the process of development and economic growth in developed countries impacts negatively on developing countries. Akpan (2003) noted that these latter are predominantly ex-colonies suffer from negative terms of trade and are caught in the debt trap, hence submitting to a technology industrial dependency. An example could be seen in the outsourcing industry when it has been argued that the production of offshore computing and commodities are done to improve the societies of developed countries rather than the economies of developing countries (Sein & Harindranath, 2004)

The ICT4D literature is yet to establish a direct relationship between ICTs and economic development in developing countries (Akpan, 2003; Avgerou, 2003). Hence, it could be argued

that investments in ICTs may have failed to achieve their anticipated developmental goals (Heeks, 2002). This could be due to inappropriate intervention approach planned to guide development (Soeftestad & Sein, 2003) or failure to take into account the socio-cultural context during the design and implementation of the ICT4D interventions (Maumbe et al., 2008). As such, there has been a call for more emphasis on investigating the contextual and social aspect of ICT4D interventions given that the failure or success of ICT4D interventions will depend on their "fit" with the economic, political, social and cultural contexts in which they are implemented (Walsham, 2007, Heeks, 2008). Despite the growing number of research within the ICT4D domain, Mbarika et al. (2005) noted that research focusing on ICT4D interventions in Africa is still at a moot point in the dominant information systems research. Thompson and Walsham (2010) called for research focusing on ICT4D in Africa and the need to expand beyond the use of ICTs in Africa to include deeper developmental concentration. In this study, the authors aim to address the research question: *"What are the challenges of implementing international computing curricular in African Universities?* This is done in order to provide implications for research and policy makers advancing an agenda of "ICT for Development" in the education sector. As noted earlier, the paper is informed by the design reality gap framework to evaluating the implementation of ICT4D projects, which the following section discusses.

CONCEPTUAL FRAMEWORK

The Design Reality Gap

The design-reality gap is a broad framework that was drawn upon from the literature on contingency in organizational change (see Venkatraman, 1989) and social construction of technology (see Suchman, 1987). The framework was developed by Richard Heeks and is used to analyze organizational change and the risk associated with it. In the domain of ICT4D, the design reality gap has been adopted as assessment tool to measure the success of ICT4D projects. The model has helped to explain the mismatch between ICT4D designs and local user actuality. This gap occurs because the contexts of the project beneficiaries and the ICT4D project designers are often distant in socio-economic and cultural dimensions, hence this results in specific design assumptions which do not fit to the local realities (Heeks, 2002). Hence, ICT4D failure or success would depend on gap that is present between the design of the ICT4D project and the current realities. According to Heeks (2002), the design reality gap exists around seven dimensions abbreviated as ITPOSMO: Information, Technology, Processes, Objectives and values, Staffing and skills, Management systems and structures, and other resources such as time and money.

In the discourse of ICT4D, the framework has been criticized for focusing on *"point"* implementations of ICTs in developing countries with lack of an explicit developmental focus (Thompson and Walsham, 2010). Despite the criticisms, there has been much progress and efforts by ICT4D researchers in applying the design-reality gap model in IS in developing countries studies to understand why majority of ICT4D projects fail (see Heeks, 2003, Heeks, 2002; Dada, 2006; Bass & Heeks, 2008). Specifically, in the studies of ICT in the institutions of higher education in developing countries, very few authors have applied the design reality gap (see Bass and Heeks, 2008). Bass and Heeks (2008) extends the original design reality gap to include milieu which address the issues of politics and legislation in order to the failure or success of the implementation of an international computing curricula in Africa using a case study of Ethiopian higher education. This paper further constitutes an effort of operationalizing the extended design reality gap by using its basic concept to analyze the design and implementation of an international styled computing degree program in Nigeria. The contribution of this paper is in two folds: operationalizing the design-reality gap framework by showing its theoretical and practical significance and drawing up implications for stakeholders in the higher education sector

by providing recommendations for practice. The following sections will introduce the extended design reality gap and its core dimensions that is applied in this paper.

Dimensions of the Design Reality Gap

The extended dimensions of the design reality gap can be summarized with the OPTIMISM mnemonic (Heeks, 2008):
   - Objectives and values (both formal strategies and culture, and informal goals)
   - Processes (from individual tasks up to broader business processes)
   - Technology (not just ICTs but other relevant technologies)
   - Information (data stores, data flows, etc.)
   - Management structures and systems
   - Financial Investment
   - Staffing and skills
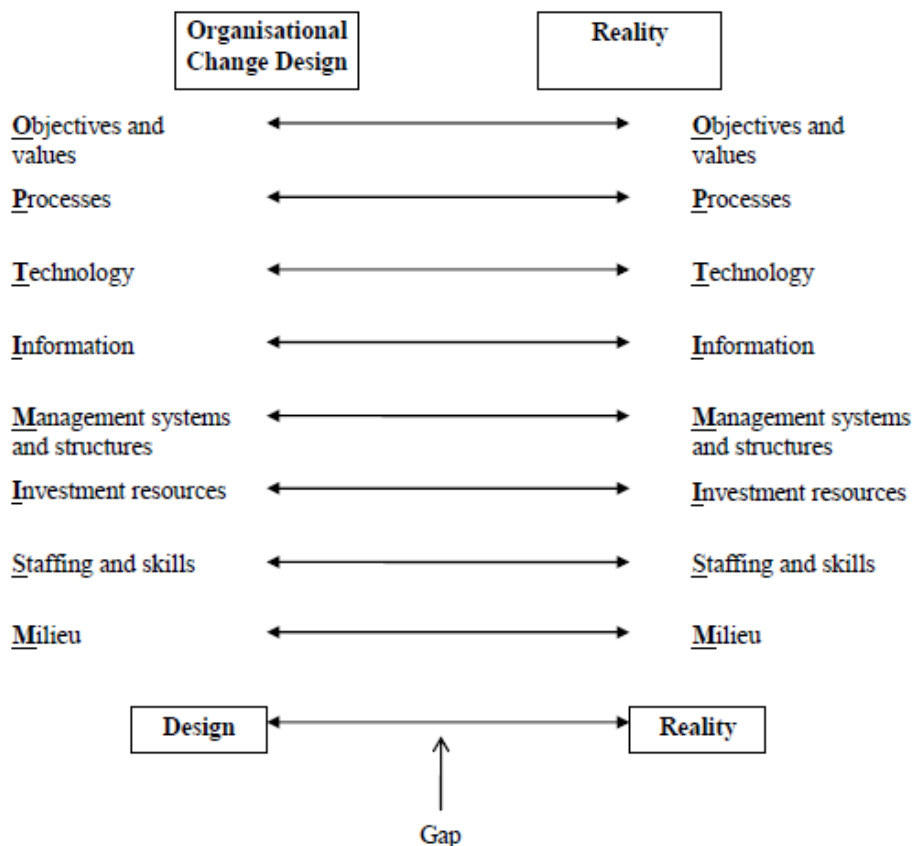   - Milieu (the external political, economic, socio-cultural, technological and legal environment)

Figure 1: The Design Reality Gap Model

Putting these dimensions together with the notion of gaps produces the model for understanding success or failures of IS in developing countries, that is shown in Figure 1. In this paper, we apply the design-reality gap to evaluate the implementation of a European computing curriculum in Africa. We will explain next how this was specifically applied in our particular study.

Table 1: *Interpretation of the design reality gaps in terms of Research Issues*

Elements of the design-reality gap model	Interpretation of the framework in terms of research issues
Objectives and values	-What are the objectives of the computing degree programs and how do they meet the requirements of the stakeholders affected by this degree programs? -What are the values embedded within this international degree programs? How do these values match the underlying values of the stakeholder's realities?
Processes	-What teaching and assessment methods are available to support these degree programs? -Are these teaching and assessment methods effective to support these degree programs?
Technology	-What Infrastructures are available to cater for the students taking these computing degree programs? -Are these infrastructures enough to cater for all the computing staff and students? Are there enough infrastructures to also support teaching and learning?
Information	-What Information flow is available to support the implementation of the degree programs? -Do students and staff have access to student information? -Do student and staff have access to teaching materials? -Do students and staff have access to external stakeholders?
Investment resources	-What considerable investment has been made to support the implementation of these degree programs?
Staffing	-What are the required staff capacity needed to support the degree programs? Are there enough staff to support these degree programs? Do these staff have the right skills to teach the individual subjects?
Management system and structures	How is the management and structure of the university and its faculties? Can the design of the international computing degree programs be embedded within the structure and management of the university?
Milieu	What are the legal and political requirements for the successful implementation of these degree programs? How do they affect the successful implementation of these degree programs?

In the following section, the research methodology and methods of data collection is presented.

METHODOLOGY

Research Approach

This research followed a broad interpretive approach. According to Walsham (2006), the interpretive research aims to understand social setting and realities of ICTs in use. A case study design was adopted in this study due to its strength in allowing various methods of data collection (Benbasat et al., 1987). The case study followed an explanatory line (Yin, 2003) with the purpose of evaluating the issues surrounding the implementation of international computing curricula in a private African university in Abuja, Nigeria. Multiple data collection sources which includes interviews, observation and document analysis was carried out between June and July, 2014. A total number of 17 interviews was conducted with several stakeholders who were involved in the implementation of this international curricular. Majority of the interviews lasted about an hour and all were done in English. Staff ranged from existing lecturers to newly qualified lecturers to Faculty Deans. The interviews were conducted using an interview guide based on the OPTIMISM model and were tape recorded. Interviewees were asked probing follow-up questions on new and emerging topics as well as given opportunities to raise any other issues they considered relevant.

On the whole, approximately 15.4 hours from the transcript of the interviews were gathered, organized and analyzed later. Interviews were often accompanied by observation. Four of the authors acted as practitioner researchers who Oates (2006) described as someone who already has a job and decides to put on a researcher's 'hat' to investigate their own work organization. In this study, observation was very important as the authors could observe how the degree programs were designed and the surrounding challenges affecting its implementation especially during classes, and departmental and faculty meetings. We compiled two pages of observation notes in this study. Furthermore, we analyzed the Nigeria ICT policy, university education legislation, the faculty student handbook and the faculty set up guidelines that contains all information on the course curriculum. The Nigeria ICT policy and university education legislation was downloaded over the internet while faculty student handbook and the faculty set up guidelines were provided by the university.

Table 2: Sample of Coding Process

Sample Theme	Sources	Sample-coded excerpts from transcripts/ field notes
Objectives and Values Reality	Sources: Pre-reading of transcript and Theoretical Concepts	*"We are currently achieving the objective of our faculty, as you know the department just got an NUC accreditation of 87% and after interviewing our students, they were impressed that we have developed students that possess a wide range of transferable skills including analytic and synthetic reasoning, problem solving, individual and team working, project and time management, and verbal and written communication skills" (Acting Dean)*
Information flow about course content	Sources: Pre-reading of transcript and Theoretical Concepts	*"This semester I have been assigned to teach Introduction to World Wide Web to second year students. At the moment, I don't know what course I am teaching next semester, I have to wait for the dean to assign the courses I will be teaching" (lecturer)*

All data collected were analyzed using set of principles of thematic analysis (Braun and Clarke, 2006) in order to capture the main themes discussed by the interviewees. This allowed, in the first instance, the classification of similar material and insights to be captured. Next, a set of themes were produced following the OPTIMISM model, but with careful consideration given to emergent topics as described in Table 2. The results of the case study analysis are presented in the discussion and analysis section illustrating the challenges in implementing an international curricular in Africa. The following section provides an overview of the higher education system in Nigeria.

Higher Education in Nigeria

The National ICT policy was drawn up in line with nation's vision 20:2020 agenda. The vision of the policy document is *"Nigeria as a knowledge-based and globally competitive society"* (NPFIT, 2012, pg. 12). The policy focuses on the application of ICTs in sectors of education, job creation, accountability, public administration, health, sport, transportation and agriculture. One of the key objectives of the policy is the design and implementation of an appropriate ICT curriculum in all levels of education. Thus Nigeria presents a good example of a developing country who has prioritize the use of ICTs within its education sector. Currently there are 129 universities in Nigeria which include 40 federal universities, 39 states universities and 50 private universities. The federal and state universities are public universities funded solely by the government. The National Universities Commission (NUC) which was established in 1962 and is the governing body that enforces uniform standard and sets admissions capacity of every university in Nigeria. However, institutions of higher education in Nigeria especially the public ones are confronted with several challenges such as lack of funding, poor infrastructure, corruption, shortage of lecturers, periodic strike and closure (PunchNG,2013). The challenges facing the public universities has resulted in individuals and private bodies establishing universities in the country. The first private universities in Nigeria were licensed in 1999 and they are Babcock University, Igbinedion University and Madonna University. More private universities have since been approved by the federal Government. However, many of these universities have been characterized with high tuition cost even though many students seek admission into them due to the challenges faced by the public universities.

Computer Science Programs at Institutions of Higher Education in Nigeria

Currently about 99 universities both public and private have been approved and accredited by the Nigeria University Commission to offer computer science degree programs (NUC, 2012). Based on the NUC's benchmark minimum academic standards (BMAC) for undergraduate programs in Nigerian universities, the admission requirements to study computer science requires a student to have a minimum credit level passes in five subjects including Mathematic, Physics and English. The computer science degree programs in Nigeria is a four year program (See Table 3 for course description).

However, success has not been achieved in administering computer science degree programs in Nigeria universities due to more emphasis on theory with little focus on practice. This could be due to the lack of infrastructures to support the practical aspect of these courses and also the limited experience in running practical lab sessions hence exposing instructors who have been educated through a system that had a paucity of such learning opportunities (Bass and Heeks, 2008). Hence, many of the Nigeria universities produce insufficient and ill-prepared science graduates necessary for driving the economic development of the nation (Uwaifo, 2010).

Table 3: **Course Description for Four Years Computer Science Degree Program in Nigeria**

<table>
<tr><th colspan="5">Course Description</th></tr>
<tr><th>First Year</th><th colspan="2">Second Year</th><th>Third Year</th><th>Fourth Year</th></tr>
<tr>
<td></td>
<td>Course Tile</td><td>Credits</td>
<td>Course Tile   Credits</td>
<td>Course Tile   Credits</td>
</tr>
<tr>
<td>Introduction to Computer   3
 Science
 Introduction to Problem Solving   3
General Mathematics I   3
General Mathematics II   3
General Mathematics III   3
General Physics I   3
General Physics II   3
General Physics III   1
General Biology I   3
General Chemistry I   3
Use of English   2
Library Skills   1

Electives 6 Units to be selected from
Mathematics and Physics Courses.</td>
<td>Computer Programming I
Computer Programming II
Foundation of Sequential Program
Fundamentals of Data Structures
Operating Systems I
Discrete Structure
Computer Hardware
Foundations of Sequential
Programme
Mathematical Methods
Electronics
Industrial Training
 Entrepreneurship Studies
Communications Skills

Electives 8 Units to be selected from
Course Tile   Credits
 Linear Algebra I   3
Linear Algebra II   3
Modern Physics and   3
Statistics courses</td>
<td>3
3
3
3
3
3
3

3
3
3
2
2</td>
<td>Structured Programming   3
Object-Oriented Programming   3
Algorithms and Complexity Analysis   3
Operating Systems II   3
Architecture and Organization I   3
Architecture and Organization II   3
Data Management I   3
Compiler Construction I   3
Systems Analysis and Design
3
Survey of Programming Language   4
Computational Science & Numerical
Methods   3
Formal Methods and Software   3
Development
Industrial Training II   3
Entrepreneurship Studies II   2

Electives 6 Units from
Course Tile   Credits
Operations Research   3
Numerical Analysis   3
Statistical Computing   3
Theory of Computing   3</td>
<td>Software Engineering   4
Data Management II   3
Net-Centric Computing   3
Organization of Programming   3
Languages
Artificial Intelligence   2
Human Computer Interface   2
Computer Networks   3
Communications
Project   6

Electives 9 Units to be selected
from
Course Tile   Credits
Compiler Construction II   3
Computer Graphics and
 Visualization   2
Modeling and Simulation   3
 Information Technology Law   2
 Optimization Techniques   3
Queuing Systems
Performance Evaluation   3
Project Management   3
Special Topics in Software
Engineering   3
Computer System Performance
Evaluation   3
 Distributed Computing System   3
Formal Models of
Computation   3
 Special Topics in Computer
Science   3</td>
</tr>
</table>

Source: NUC Minimum Benchmark 2007

Other issues affecting the provision of computer science degree programs in Nigeria include issues ranging from non-availability of adequate human capacity, poor funding, poor staff training, brain drain and retention profiles, poorly equipped laboratories and inadequate ICT environment. Recently, many private universities have evolved in Nigeria in order to address the challenges that are faced by the public institutions. Many of these private universities offer computer science degree programs and have adopted international computing curricula in order to produce graduates that not only can compete locally but also internationally in the technology driven society. This paper explores one of those efforts where a private university within the capital of Nigeria introduced an international curricular (British) in its Faculty of Applied Sciences and Computing in order to produce graduates that will understand the principles that lie behind the current computing technology and also develop the ability to adapt their skills to the new technology.

Baze University, Abuja

Baze University was granted its license by the Nigeria Universities Commission (NUC) to operate as private university in 2011 and in the same year, it opened its doors to its first students. Founded by a former senator in Nigeria, it is located in federal capital territory, Abuja, the state capital of Nigeria. Having benefited from the UK education system of instruction, the founder sought to make this style of education - focusing problem solving, small classes, and a British style general education program. Currently, the VC of the university is a British Professor whose experience has been an educationist across the globe and a former VC to a university in Eastern Africa. The University is home to about 1300 students and 98 faculty members and consists of three Faculties: Applied Sciences and Computing, Business and Law.

In this study, we concentrate on the Faculty of Applied Sciences and Computing, specifically the Department of Computer Science. The Department consist of a Head of Department and 16 academic staff. Currently the degree program offered by the department can be seen in table 4.

Table 4: **Baze University faculties and degree programs**

Faculty of Applied Sciences and Computing	Faculty of Business	Faculty of Law
B.Sc. Computer Science B.Sc. Chemistry (Petroleum Chemistry) B.Sc. Physics (Physics with Computing) B.Sc. Mathematics (Financial Mathematics) B.Sc. Biology (Biological Sciences)	B.Sc. Accounting B.Sc. Banking and Finance B.Sc. Economics B.Sc. Management B.Sc. Marketing B.Sc. Government Public Administration B.Sc. International Relations and Diplomacy B.Sc. Psychology	LLB Jurisprudence & International Law LLB Business Law LLB Private and Public Law

DISCUSSION AND ANALYSIS

In this previous section, the authors have discussed the higher education sector in Nigeria and the context of computer science degree programs. The authors have also examined the ICT and education policy documents in order to understand the motivation and process behind the provision of computer science programs in Nigeria universities. We have also provided an overview of the case study. Now we examine the implementation of an international (British) curricular of computer science at Baze University using the design reality gap model. Using the model, we focus on the match and mismatch of implementing this curricular using eight OPTIMISM dimensions of the model.

OBJECTIVES AND VALUES

Design Expectations

The objectives of Baze university states *"to establish and maintain a most suitable academic environment synergizing world-class human capital and best technology for creating and imparting knowledge to develop and modernize the Nigerian society".* The faculty of applied sciences and computing was designed to develop graduates that will possess theoretical and technical knowledge of computer science and IT, sound practical and algorithm skills, and an appreciation of computing in society, business, medicine education, industry and government, and an understanding of the social, legal and ethical aspects of computing (Baze University Student Handout). The programs within the faculty are guided by *Benchmark Minimum Academic Standards (BMAS)* Science 2007 for the accreditation of Computer Science programs in Nigeria and by the requirements of the British Computer Society (BCS) for the accreditation of Computer Science programs in British Universities.

Reality

The core value and objectives of faculty of computing did appear to be shared in reality by key stakeholders. Many interviewees spoke of the new focus on graduate capabilities in terms of subject-specific skills. They appreciated the pressing need for graduates to be confident and be able to engage responsibly and productively in the computer industry at whatever level they propose to undertake as illustrated in the quote below:

> *"We are currently achieving the objective of our faculty, as you know the department got an NUC accreditation of 87% and after interviewing our students, they were impressed that we have developed students that possess a wide range of transferable skills including analytic and synthetic reasoning, problem solving, individual and team working, project and time management, and verbal and written communication skills"* (Acting Dean)

Design-Reality Gap

The interviews and observations in the study appears to have shown that there is a relative good match between the design expectations and individual stakeholder realities.

INFORMATION

It was agreed that the success of the design of degree courses within the faculty was based on the fact that effective learning and teaching required effective information flows between a network of stakeholders which include students, staff and external stakeholders.

Reality

Access to teaching and research materials

Usually the dean of the faculty always makes sure that the books needed by the staff are made available in order to allow them prepare lecture materials especially for new courses introduced in the curriculum for the first time. Lecturers have access only to free online journals and the faculty is yet to subscribe to any of the e-library channels. Normally, lecturers contact colleagues or friends who have access to online materials. The lack of staff access to updated online materials impact course preparation by encouraging inheritance of old lecture materials and also affected the output of research work as shown in this quote:

> *"Publishing and preparation of teaching materials have been a little bit challenging here in Baze because we don't have access to journals like the UK University. You know subscribing to this journals requires millions of naira which is so expensive. So for me what I do is just contact my colleagues who are in the UK in order to access this journal libraries" (Lecturer A)*

Information flow about course content

We found evidence that the new course structure within the computing faculty had not been sufficiently disseminated to both teaching staff and student. Our interview with the lecturers show that some of them do not know what courses they will be teaching in the following semester:

> *"This semester I have been assigned to teach Introduction to World Wide Web to second year students. At the moment, I don't know what course I am teaching next semester, I have to wait for the dean to assign the courses I will be teaching" (Lecturer B)*

We also found evidence that at the end of the semester, many of the students are unaware of the courses they will be taking in the following semester. Many of the students become aware of the courses they are taking at the point of their registration.

Information dissemination with external stakeholders

One of the major objectives of the faculty is to prepare graduates that would be attractive to employers. Yet there appears to be little communication with external stakeholders. One of the first priorities of the newly designed Faculty of Applied Sciences and Computing was the need to communicate with potential employers of the graduates. Many large employers in the public and private sector would benefit from understanding the various degree programs the faculty was offering and the various job roles suited for these various degree programs. By interacting with employers, students will be provided with opportunities to develop the skills that employers are looking for. Although during their 3rd year, it's mandatory for all students to undergo industrial training in external organizations, thus providing opportunities to gain real-world perspective and exciting opportunities. It was observed during the research that it was the duty of the students to find this organizations on their own and those students who are unable to find a place are attached to the IT department within the university. We also found out that there was no formal link between students and external stakeholder such as the Nigeria Association of Computer Science Students (NACOSS). However during the course of writing this paper, the Faculty had started making strides in interacting with external stakeholders by organizing an international

conference on science and technology. Many of the lecturers had started making formal links with old colleagues and corporate bodies in order to have them attend the conference. This effort will boost the image of the Faculty and the University at large.

Design Reality Gap
While the university has been successful in setting up a computing faculty, our study has shown that there are still some few challenges to deal with. However, the Faculty's plan for an international conference has helped to reduce the design reality gaps in terms of information.

PROCESSES

Generally, public institutions have tended to rely on traditional lecture methods and student assessments. This echoes a didactic attitude of lecturers in developing countries, who see teaching processes as restricted to purely theoretical information transfer to students (Bass & Heeks, 2008). However, during the design of the computing courses at the Baze University, the policy design included assessment and lecture diversity. The design envisaged new teaching and learning processes that included lecture hours, interactive lectures, case study presentations, laboratory sessions, group project, class test, and continuous assessment of project work and assignments. The design on the teaching and learning methodologies puts priority more on providing opportunities for students to have both theoretical and practical engagement with the subject matter.

Reality

The faculty has completely embraced assessment and lecture diversity. The process of teaching and assessment has moved from the traditional methods which are more theory focus to a students' oriented teaching as shown in the quote:

> *"The diversity in the teaching and learning method is for students to do critical thinking which will lead to better understanding and should involve problem solving. That's what you do when you are working. You are thinking about problems and trying to find ways around it. They need to understand what the difference is, that is why critical thinking is so important. They should be aware of their problems and be able to address them especially in computer science courses" (Acting Dean).*

The Faculty of Computing has embraced the need for continuous and practical assessment in order to continuously engage the students. Usually the faculty prescribes a 40% weighting for continuous assessment and 60% for final examination that should be applied to all courses.

Design-Reality Gap

For now, there has not been so much of a design reality gap with regards to the faculty processes in terms of assessment and teaching diversity. Teaching in the faculty has been more student oriented with diverse methods of assessment hence broadening the base for practical work.

MANAGEMENT SYSTEMS AND STRUCTURES

The faculty of computing was designed to have a Dean in charge of the whole faculty, a faculty secretary and its various academic staff. The Dean subsequently reports to the Vice-Chancellor of the university. In 2012, the school was granted the license to run science degree courses in Financial Mathematics, Physics, Petroleum Chemistry and Biology. Thus the university

restructured the Faculty of Computing to accommodate these sciences courses and it's was renamed the Faculty of Applied Sciences and Computing in 2012.

Reality

With the proliferation of courses, the structures of the faculty was not in line with the requirements of NUC. The NUC policy required a faculty to have a dean, and heads of Department within the Faculty. Each of this department is headed by a head of department (HOD) who reports to the faculty dean. The faculty undertook a major business process re-engineering about teaching and learning across all courses in order to get its degree programs accredited. During the business process reengineering stage, it was found out that during the design for the computing faculty, there was little or no consideration of quality assurance procedures for faculty courses. There were also no staff promotion and welfare review during the faculty design process. However, the NUC accreditation process in the faculty led to a detailed commitment to quality assurance, institutional and individual course reviews.

Design Reality Gap
In terms of management systems and structures there is a relatively small design-reality gap due to the ability of the university to be more flexible in its structuring.

INVESTMENT RESOURCES

The availability of funding has always been an issue in institutions of higher education in developing countries. In Nigeria, just like public universities, private universities have equally complained of funding and have clamored for funding and investment from the government. They argue that they are playing an identical role to public universities in producing much-needed skills for the country, and thus deserve state funding (Fatunde, 2013). As a new University, the need for investment to support the Faculty and its curriculum was given sufficient attention by the university board members.

Reality

Baze University has enjoyed a considerable amount of funding and investments from the founder. The steady increase of investment by its founder has enabled the development of its new, modern teaching labs, infrastructure and its science library. The faculty recently subscribed to Microsoft dreamspark hence providing professional developer tools and software in the hands of faculty staff and students with a low-cost subscription from Microsoft. However, the study shows that there was need for further investment on computing textbooks to support teaching and learning. The purchasing process is hampered by a shortage of good quality textbooks in the country. We observed that the textbooks in the science library could not cater for the growing number of students within the computing department. When asked with regards to this issue and how it affects teaching and learning, one of the lecturers noted that:
> *"In the department, when a lecturer is in need of a textbook, we make a request directly to the Dean who orders some few copies when he travels to the UK. One is given to the instructor and the rest to the libraries. Usually, due to its limited availability of copies in the library, our students usually download the textbooks online and sometimes not all this books are available for free download, so it's an issue to be dealt with" (Lecturer C)*

The inadequate computing textbooks and materials have resulted in faculty members investing a considerable amount of personal time to the preparation of course and teaching materials. This include spend evenings and weekends in order to prepare lecture materials.

Design-Reality Gap

In summary, the issue of funding seems to affect the whole university sector in Nigeria which includes not only public institutions but also private institutions. We found evidence that with the huge amount of money that was involved in setting up the university, every investment that will be made on an existing department usually depends on the amount of profit that the faculty returns based on the amount of students enrolling to that department. This has resulted in private universities in Nigeria also asking for funding from the government on the bases that they are also contributing their quota to the development of the country even though some argued that private universities are created as profit-making ventures and are therefore not entitled to taxpayers' money, which should be invested in public institutions.

TECHNOLOGY

Design Expectations

The design of the Department of Computer Science guidance framework draws out the importance of having adequate IT infrastructure to support teaching and learning. These include library and computer classrooms and labs.

Reality

The university has sufficient air-conditioned teaching class rooms equipped with wireless internet and a projector. Also, the university has three IT laboratories to teaching specialist topics such as database, web programming, word processing applications and programming languages. During the inception of the faculty in 2011 there were no labs with networking capabilities to support advanced studies in networking. However in 2013, a network lab was established with adequate facilities to support network and operating system courses as shown in this quote:

> *"When I came in, I noticed we didn't have a network lab to illustrate to the student the practical aspect of networking. I followed it up with the dean and in less than a month, the lab was up and running. You know we are trying to give our students the best experience their friends and families are also getting in the United Kingdom". (Lecturer D)*

There were also some challenges such as poor internet connectivity, poor infrastructures and limited amount of computers hindering a good level of access to the IT labs as illustrated in this quote:

> *"Sometimes when we get into the lab to do our course works only to notice that some computers don't have internet access or the software are not properly working. That is why most students get their personal computers." (Student B)*

Design-Reality Gap

Our study indicates that the relationship between a supporting teaching and learning environment and the ICT subjects is still at a moot point. The study shows that a design reality gap exists and constitutes a hindering factor to the newly implemented ICT courses in the university. The study shows that general purpose computer classroom is not enough to cater for the student population. Furthermore, there is inadequate internet access around the university campus. All academic and administrative building are fully connected with both LAN and wireless internet connections with the exception of the school accommodation and cafeteria. When students want to use the internet, they will have to go to these buildings or use their own private internet modems.

STAFFING AND SKILLS

The design of the new faculty and degree programs highlighted the importance of having adequate university teaching staff with appropriate qualifications and experience. Having the right amount and quality of both academic and administrative staff were significant for getting a full accreditation of its courses from the NUC. However, student's skills in terms of gaining practical industrial experience during their study was not stated and discussed in the policy guideline regarding the formation of the faculty.

Reality

In reality, the faculty started with only 4 academic staff and 16 students in 2011. Some of them had none or little experience in the academia, amongst the new staff, one was a Professor and the other was a PhD holder. The other two lecturers were building up their skills and expertise over time on the job, but this could not yet reach the design expectations. Some of the instructors were finding it challenging to teach core programming courses because of their lack of experience in academia. The number of staff was generally regarded as being inadequate due to growing number of students. However, for the university to get its computer courses adequately taught, the university needed to employ more experienced academics which it did even though there was a shortage of suitably qualified and experienced staff from which to recruit. The shortage of skills is particularly felt in the computer science stream which requires core programming. Also, the NUC had a problem with the design of the computing curriculum. In Nigeria, all students undergoing a science course are required to take a mandatory three month industrial training. As such, the Faculty was obliged to introduce the compulsory industrial training for its student during their third year. With such policy, the faculty couldn't implement the British style curriculum for achieving a BSc in computer science in three years.

> *"We are trying to implement a British style educational system where our students can obtain a computer science degree in three years just like the UK. But I don't think we can achieve that with the mandatory industrial training policy of the NUC here in Nigeria unlike the UK where placement is optional" (Acting Dean)*

MILIEU

Design

In the previous session of this paper, the authors already discuss the contextual factors that affect the design and the implementation of the degrees within the computing faculty. They include economic in the discussion on funding and investment, socio-cultural in the discussion on objectives and values, technological in the discussion on technology. In this section, we concentrate on the legal and political context which are both usually sensitive topics that participants shy away from.

Reality

In terms of politics, the present government under the watch of President Goodluck Jonathan has been supportive of private sector investment in the education sector. Politically, the establishment of the university and its various degrees is in line with the economic transformation agenda of the President. Since the assumption of office by the president in 2011, the president has established 12 federal universities and he has issued license to nine private universities including Baze University and three state universities. During the former Minister of Educations tour at Baze University after paying a courtesy call, while touring the network lab of the faculty, she stated:

> *"I must say that we are impressed with what we have seen. I have already said kudos to the university management and students that the university has been established both in terms of improving access at the same time with the requisite qualities that we require" (Former Minister of Education)*

In this study, the legal context of the design of the computing faculty and its degree courses is centered on the NUC accreditation. According to NUC, all universities in Nigeria must comply with approved Benchmark Minimum Academic Standards (BMAS) and other quality assurance instruments required for Nigerian universities to meet national needs and global competiveness based on the Nigeria education law of decree 49 of 1988. The NUC visited Baze University between February to March 2014 for the accreditation exercise of the degree courses within the Faculty of Applied Sciences and Computing. The review focused on course curriculum, staffing, research, infrastructure, and an acceptable standing of teaching and learning. After the three day process, the Department of Computing received an Interim accreditation.

Design-Reality Gap

Our study shows that both the legislative realities and political requirement appear to be largely met. It can be concluded that the design-reality gap with regards to milieu is at an extinct point.

CONCLUSION AND RECOMMENDATION

In this paper, the authors have further shown that design reality gap framework can be applied to the implementation of ICT curricular programs in developing countries. As ICT4D researchers, our aims is to study the relationship between ICT and development. However by adopting the design-reality gap, we are forced to do that by providing a comprehensive evaluation of the implementation of an international ICT curricular in a developing country and exposing many issues that are pre-requisite for the successful implementation of the western computing curricular. The importance of the choice aspect in the design reality gap means that it is crucial to understand the social, cultural and political context, and evaluate the ICT curricular towards that.
In this study, we also suggest some recommendations based on the mismatch associated with implementing this international curricular. To address the large gap identified in the staffing and skills area, the university should provide in house training to its existing and newly appointment staff in order to address the shortage of technical skills especially in the areas of programming. This can be done by going into private and international organizations such as NIIT, APTECH, Microsoft, Google and others for ICT technical manpower development. Also, there is need for the university to increase its internet bandwidth in order to provide wireless internet access across the whole campus in order to support meaningful academic activity. The university should liaise with bigger telecommunication providers such as MTN, GLO, and ETISALAT in order to setup its own secure wireless network that will provide a fast and uninterrupted wireless internet across the whole campus.

Also, with regards to the shortage of international computing textbooks, preferable the ones in use in UK Universities since the university is following the British standard, the university can improve the situation through interlibrary loan and document delivery service with a couple of UK universities where the students can have access to read the e-books by logging into the partner UK university library. This will also give the students and lecturers not only access to e-books but also online academic journals the UK universities could have been subscribed to, hence encouraging learning, teaching, research and university partnership. To enable urgent address to all the gaps identified, funding needs to be given a key priority to enable capital investment in

support of curriculum development. Most private universities solely rely on the founder for funding and the bulk of such fund goes to servicing the overhead cost. The faculty should source from donors and private organizations such as Mac Arthur Foundations, Shell, and Google etc. For example in 2010, the Mac Arthur Foundation awarded grant to Bayero University Kano to complete it ICT Centre (McFound, 2010).

In summary, the implementation of any western designed ICT curricular in a developing country needs to shift beyond the directly as-it-is implementation of such curricular to adapting it to the cultural, institutional, social and political context where it is to be implemented in order to encourage success. In suggesting the potential for future research, the limitation of this study is recognized. The study was limited in that only a single focused case study was undertaken under severe time limitations; however there is scope for undertaking a longitudinal study on the basis of the current results to provide more insight on implementation issues as the university continues to expand in regards to student size and also computing courses. Lastly, the findings of this study cannot be generalised due to the choice of research strategy but can give insights by drawing specific implications for actors involved in the implementation of international ICT curricula as well as researchers that plan to investigate similar subjects in different context

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