

Original Article

Quality Materials Science Education for Sustainable Development through Distance Learning: the Case for Nigeria and Zimbabwe

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ABSTRACT

Zimbabwe is rich in human capital and natural resources, and is poised to achieve sustainable growth and development mainly through human capital development. The purpose of this paper is to explore the use of open and distance learning (ODL) in materials science education. The major objectives of the research are to:

- identify and assess the main regulatory frameworks that apply to distance and online education in Nigeria and Zimbabwe.
- ascertain the feasibility of offering materials science education programmes through open and distance learning (ODL).

The methodology was mainly a qualitative case study focusing on Nigeria and Zimbabwe. The two countries were purposively sampled to represent two distinct types of policy and regulatory environments. Data collection comprised literature and document review, administration of questionnaires, and field visits to conduct interviews with relevant ministries, regulatory agencies and selected universities. Data collection instruments were questionnaires and interview schedules.

Nigeria has a population of about 154,729,000 as at 2009, distributed as 51.7% rural and 48.3% urban, and with a population density of 167.5 people per square kilometer. The National Universities Commission (NUC) regulates a total of 117 Universities countrywide and provides accreditation at institutional, programme and course levels. Quality assurance is monitored to promote standards and ensure safety with minimum academic standards. The National Open University of Nigeria (NOUN) is currently the only Uni-mode University mandated for Open and Distance Learning (ODL) in the delivery of university education. There are about six universities which may be regarded as dual- mode universities with limited capacity to deliver degree programmes by the ODL mode in addition to the conventional face-to-face mode. NUC has one of the best regulatory frameworks in the world that promotes quality ODL programmes. The lessons learnt from Nigeria can be adapted and applied to Zimbabwe and ZOU in the offering of degree programmes for materials science and courses in nanotechnology, through ODL and e-learning.

INTRODUCTION

Both sustainable development and economic growth require innovation. Science, Technology and Innovation (STI) effort is usually measured by specific indicators which normally include science enrolment rates in secondary, technical, vocational, and tertiary institutions; national spending on science and technology education; research and development spending; research output of institutions, etc. Materials science, a element of STI, is defined as the study of the properties of solid materials and how those properties are determined by a material's composition and structure. (VCSU, 2006). The materials could be metals, ceramics, clothes, semiconductors, etc. Nanotechnology is a new branch of materials sciences.

The purpose of this paper is to explore the use of open and distance learning (ODL) in materials science education. **Distance education** is an approach of delivery or methodology where the learner is separated from the instructional base or teacher, either in space or time, for a significant portion of their learning. Distance education is defined by the American Council for regional accrediting commissions (CRAC, 2001) as a formal educational process in which the majority of the instruction occurs when student and instructor are not in the same place. In this paper, the term **Open and distance learning (ODL)** refers to a philosophy of learning that uses an array of educational methods and is based on the principle of flexibility to increase access to and equity in openness with

a specific role to achieve a development function, social justice/access, and social mandate aimed at developing human capital.

Zimbabwe is rich in human capital and natural resources, and is poised to achieve sustainable growth and development. A necessary condition for sustainable development is human capital development, which is central to capacity development. **Human capital** is about “the knowledge, skills and competences and other attributes embodied in individuals that are relevant to economic activity” (OECD, 1998). Human capital is an asset and a factor of production, that can be measured at individual, corporate and national levels. Knowledge-driven sustainable development requires relevant and efficient development knowledge. Knowledge is the centrality of sustainable growth and development in many ways, and has become the new currency in the modern age and in spearheading Zimbabwe to become a knowledge-based economy. The modern workforce is now required to possess and amply demonstrate capability of adjusting and attaining investigative skills, thinking critically, working independently with others, and application of knowledge and skills to different situations and subject to constant change. The four pillars of a knowledge economy and sustainable development are:

- **Human capital** - an educated and skilled population to create, share, and use knowledge well;
- **ICTs** - a dynamic information infrastructure to facilitate the effective communication, dissemination, and processing of information;
- **Institutions** - an efficient innovation system comprising academia, firms, consultants, SMEs, etc.;
- **An enabling policy and legal framework** - an enabling environment with supportive economic and institutional mechanisms.

The core Materials Science education curricular includes areas such as Introduction to Materials; Experimental Techniques; Thermodynamics; Transport Properties; Phase Equilibria; Phase Transformation; Kinetics; Structure; Characterization; Mechanical Behavior; Electronic, Magnetic, and Optical Behavior; Synthesis, Processing, and Manufacturing; Materials Selection and Design; and Failure Analysis. Materials science education in most African universities is taught through the conventional mode, like other engineering-related fields. In Canada, Athabasca University continues to develop and thrive in e-learning. Most Australian universities developed substantial capability in distance learning in the 1980s and several have now migrated this to e-learning, including the best known the University of Southern Queensland (Bacsich, 2004). In Africa, the African Virtual University is the main player, and has operations in several African countries with instruction in both English and French. The University of South Africa has an active Online Campus and offers some programmes in the engineering and science disciplines. Other ODL players include Zimbabwe Open University (<http://www.zou.ac.zw.zouonline>). The emergence and convergence of information and communication technologies (ICTs) has remained at the centre of global socio-economic transformations. If implemented properly and carefully, these technologies could reduce or eliminate the imbalance between rich and poor, and powerful and marginalized (Kabanda G., 2011).

The major objectives of the research are to:

- i) identify and assess the main regulatory frameworks that apply to distance and online education in Nigeria and Zimbabwe.
- ii) ascertain the feasibility of offering materials science education programmes through open and distance learning (ODL).

LITERATURE REVIEW

ODeL and Blended Learning in Materials Science

The African Virtual University (AVU) stands among other tertiary education networks in Africa at the forefront of the efforts to harness the full potential of ICTs for education on the continent. As an educational network, the AVU uses ICTs to provide, in collaboration with partner universities across the continent, quality education to a wide array of learners, including traditional students, life-long learners and active workers and professionals. The AVU has more than 50 academic partner institutions in more than 27 countries in Africa. The AVU envisions an African higher education scene in which Open, Distance and e-learning (ODeL) will play an increasingly significant role. In

Zimbabwe, the University of Zimbabwe hosts the ODeL Centre for AVU. The purpose of ODeL Centres is to act as physical hubs for the creation, organization and sharing of knowledge as well as the development, delivery and management of ODeL Programs at AVU Partner Institutions (<http://www.avu.org/AVU-Multinational-Support-Project/odel-centers.html>).

In "hybrid" classes, a significant amount of the course learning activity has been moved online, making it possible to reduce the amount of time spent in the classroom. Traditional face-to-face instruction is reduced but not eliminated. The "hybrid" course model is also referred to as "blended." According to the University of Wisconsin - Milwaukee (http://www4.uwm.edu/lrc/hybrid/faculty_resources/advantages.cfm), the main advantages of hybrid learning include the following:

1. **New teaching opportunities:** Faculty can teach using a variety of online and in-class teaching strategies, which make it possible to achieve course goals and objectives more effectively.
2. **Student engagement:** Instructors claim to be more connected with their students and are able to get to know them better since they communicate both online and face-to-face, through increased and extended instructor-student and student-student connectivity.
3. **Increased student learning:** Students learn more in the hybrid format than they do in traditional class sections, write better papers, perform better on examinations, produce higher quality projects, and are capable of more meaningful discussions on course material when reflecting online.
4. **New pedagogical approaches:** Learning to teach a successful hybrid course leads to using more participatory and student-centered learning activities, as the teacher-student relationship is transformed to be more centered on student learning.
5. **Documenting the process as well as the product of learning:** The course management system increases pedagogic efficiency because of its ability to organize the course and automate some basic activities such as quizzes, grading, and surveys.

Quality Assurance in Higher Education

There is an increase in public accountability for higher education which compels institutions to demonstrate quality within the programmes and processes, including those provided online. Access to quality education empowers learners to transform themselves and their social, environmental and economic reality toward greater sustainability. In its Second Decade of Education, the Education Division of the African Union defined a Quality Management goal of the African Union which is ***"To build and implement a sound quality management system in Africa"*** (<http://au.int/en/dp/hrst/node>). Besides the link between quality of education and economic performance, the growing concern on quality has been triggered mainly by cultural relevance, impact on population, poverty and HIV/AIDS, contribution to the development process in rural areas, life-long learning and achievement of MDG goals. Numerous comparisons have been conducted for a long time on the learners' achievement in both distance and face to face conventional situations (Russell, 1996). The key findings from the comparison of identical content and hours of instruction, show that there is no significant difference between the different types of courses on the learners' achievement, as measured by, for example, grades, test scores or performance in the workplace (Verduin and Clark, 1991). The conclusions from these studies are, after (Verduin and Clarke (1991), Moore and Kearsley (1996)), that:

- a) lack of direct face-to-face contact does not necessarily affect the quality of the learning process,
- b) there is no evidence that face to face instruction is the best method of giving instruction,
- c) learning at a distance can be as effective as learning in a face to face situation,
- d) learning in any situation is successful when:
 - the course is well designed and delivered,
 - the content, method and technologies are appropriate for the learning task,
 - there is learner to learner interaction, and
 - timely instructor to student interaction and feedback.

The University's vision and mission statements set out its aims for providing a high quality student learning experience. The learning and teaching strategy sets out the objectives for the development and enhancement of the curriculum and the student learning experience. The University's Quality Assurance Framework supports these aims and objectives by specifying the responsibilities and procedures by which the standards of the academic programme and the quality of the student learning experience are managed, assured and enhanced. There has been some paradigm shift in the concept of higher education due to the changing environment (Pond, 2002). Owlia and Aspinwall (1996) studied quality frameworks in other disciplines, such as software engineering which they argued are akin to higher education and produced a conceptual framework that groups 30 attributes into the six dimensions of tangibles, competence, attitude, content, delivery and reliability, as shown on Table 1, after Usoro and Abid (2007).

No	Dimensions	Characteristics
1	Tangibles	Sufficient equipment/facilities Modern equipment/facilities Ease of access Visually appealing environment Support services (accommodation, sports, ...)
2	Competence	Sufficient (academic) staff Theoretical knowledge, qualifications Practical knowledge Up to date Teaching expertise, communication
3	Attitude (Learner Support)	Understanding students' needs Willingness to help Availability for guidance and advice Giving personal attention Emotion, courtesy
4	Content	Relevance of curriculum to the future jobs of students Effectiveness Containing primary knowledge/skills Completeness, use of computer Communication skills and team-working Flexibility of knowledge, being cross-disciplinary
5	Delivery	Effective presentation Sequencing, timeliness Consistency Fairness of examinations Feedback from students Encouraging students
6	Reliability	Trustworthiness

Table 1 - Quality dimensions in higher education by Owlia and Aspinwall (1996)

Research done by Owlia and Aspinwall's (1996) appears to be the most comprehensive dimensioning study of quality of higher education. It appears as if other studies confirm, complement all or some quality dimensions of Owlia and Aspinwall's research. Their study also recognises that quality is in the eye of the beholder. Like Owlia and Aspinwall, International Standards Organisation (ISO) standards accept that there are a number of stakeholders whose views have to be countenanced to have a holistic measure of quality. The ISO (2007) has defined their higher education (HE) quality criteria as:

- Content and pedagogical method;
- Achievements and impact of the programme demonstrated by performance indicators;
- Connection of the programme to business, governmental and other stakeholder groups;
- Replicability of the programme, i.e. whether it could be implemented elsewhere in the world; and

- Visibility of the programme, in particular in the media.

Lagrosen and Seyyed-Hashemi (2004) are another group of researchers who investigated quality from students' perspective. The research places great responsibility on increasing the quality of the student support system, as shown on Table 2 below:

No	Owlia and Aspinwall (1996)	International Standard Organisation (2007)	Hill and Lomas (2003)	Lagrosen and Seyyed-Hashemi (2004)
1	Tangibles		Resources of library and IT	Computer facilities
2	Competence	Profile of teachers	Quality of lecturer	
3	Attitude	Follow-up of students	Student support Social and emotional support systems	Information and responsiveness Collaboration and comparison
4	Content	Content and pedagogical method		Courses offered
5	Delivery	Assessment and follow-up of students		Collaboration and comparison
6	Reliability			
7		Globalisation in terms of number of nationalities of students and replicability of programme		

Table 2 – Approximate mapping of various HE quality frameworks from Usoro and Abid (2007)

Shelton Kaye (2011) conducted a review of paradigms for evaluating the quality of online education programs and identified the following common quality indicators of distance education as [Source: <http://www.westga.edu/~distance/ojdl/spring141/shelton141.html>]:

- Teaching and learning effectiveness
- Student/Learner support
- Technology
- Course Development/ Instructional Design
- Faculty Support
- Evaluation and Assessment
- Organizational/Institutional-Impact.

Standards and Regulatory Frameworks

Competencies or other desired program outcomes achieved by residency are not relevant to distance education. There is no systematic taxonomy that identifies the technology platforms and the associated pedagogical approaches employed. Experience with the Zimbabwe Open University (ZOU) shows that the key elements of the Quality Assurance Framework include the following:

1. *External Reference Points with the Regulatory Authority*
2. *Programme regulations and academic policies*
3. *Examination Boards and External Examiners*
4. *Senate programme approval processes*
5. *Programme and Module review processes*
6. *Collaborative programmes with Associates, Affiliates and other partners*

7. *Student involvement in Quality Assurance and Learner Support*
8. *Enhancement of the Quality Assurance Framework to ensure fitness for purpose and fitness of purpose.*

Accreditation refers to the process whereby an authoritative body evaluates the quality of a higher education institution or a specific educational programme in order to formally recognize it as having met certain predetermined minimal criteria or standards. There is no agreed international usage of key terms in **Quality Assurance**. UNESCO defines Quality Assurance as the systematic review of educational programmes to ensure that acceptable standards of education, scholarship and infrastructure are being maintained.¹

METHODOLOGY

The methodology was mainly a qualitative case study focusing on Nigeria and Zimbabwe. The two countries were purposively sampled to represent two distinct types of policy and regulatory environments due to the huge difference on the population size of the countries and higher education systems in different regions of Africa (West and Southern Africa).

Data collection comprised literature and document review, administration of questionnaires, and field visits to conduct interviews with relevant ministries, regulatory agencies and selected universities. Data collection instruments were questionnaires and interview schedules. Three main questionnaires were administered and their purpose and structure is summarized below.

Questionnaire	Purpose and Structure
Questionnaire Type A	This questionnaire was filled in by Chief Executives of National Regulatory Frameworks and Executive Heads of Ministries of Education, or their designated representatives.
Questionnaire Type B	This questionnaire was be filled in by the Vice Chancellors, Deputy Vice Chancellors (Academic), heads of quality assurance directorates/units and selected staff of ODL institutions.
Questionnaire Type C	This questionnaire was filled in by 5 alumni and existing students of ODL institutions.

Interviews were conducted with key personnel and students at the National Open University of Nigeria (NOUN), the Nigerian National Universities Commission Executive Management, personnel at Zimbabwe Open University (ZOU) and Zimbabwe Council for Higher Education (ZIMCHE) during the period August and September, 2011.

The infodensity of Zimbabwe in the context of Southern Africa was assessed quantitatively to explore opportunities in support of ODL and for sustainable development through effective utilization of ICTs. Data on Infodensity was obtained from the International Telecommunications Union (ITU, 2011). The 18 countries used in benchmarking Zimbabwe are South Africa, Angola, Botswana, Burundi, D.R. Congo, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

Data Analysis and Key Findings

The section below presents the key findings from the interviews and questionnaires, and literature review.

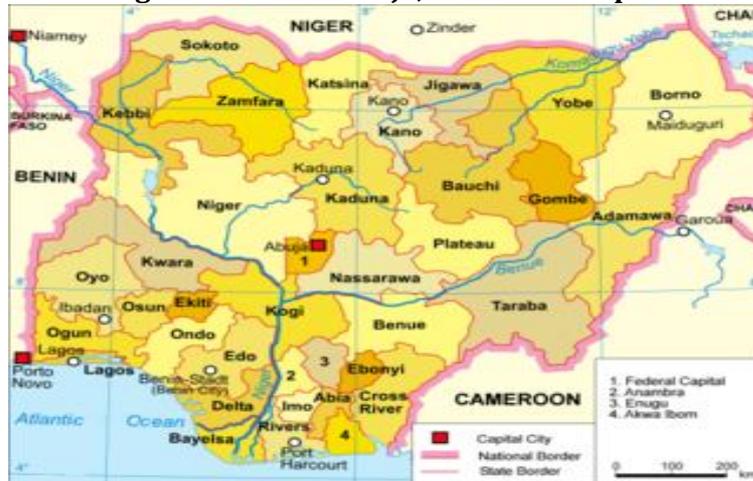
Introduction

Nigeria, officially the **Federal Republic of Nigeria**, is a federal constitutional republic comprising 36 states and its Federal Capital Territory, Abuja. Nigeria is the most populous country in Africa. The United Nations estimates that the population in 2009 was at 154,729,000, distributed as 51.7% rural and 48.3% urban, and with a population density of 167.5 people per square kilometer. About 20 million people live in Lagos. The map of Nigeria is shown in Figure 2 below.

¹ UNESCO. (2005). Quality Assurance. Retrieved January 8, 2007 from UNESCO website: http://portal.unesco.org/education/en/ev.php-RL_ID=41040&URL_DO=DO_TOPIC&URL_SECTION=201.html

The education system consists of six years of primary school, three years of junior secondary school, three years of senior secondary school, and four years of university education leading to a bachelor's degree. The National Universities Commission (NUC) is a parastatal under the Federal Ministry of Education (FME) which regulates a total of 117 Universities countrywide. The Vision of the National Universities Commission is: *To be a dynamic regulatory agency acting as a catalyst for positive change and innovation for the delivery of quality university education in Nigeria.* The National Open University of Nigeria (NOUN) is Nigeria's leading - and only specialist - provider of open and distance learning at tertiary level. NOUN is also the country's largest tertiary institution in terms of student numbers. The NOUN operates from its Administrative Headquarters located in Lagos and has 37 study centres throughout the country. Student enrolment currently stands above 32,400 and currently offers over 50 programmes and 750 courses, stair casing through from certificate to diploma and degree level, and maintaining a strong commitment to internationalisation. Educating the workforce of today -- and tomorrow -- is a key focus.

Figure 2: The 36 States of Nigeria and then Abuja, the federal capital territory.



National Open University of Nigeria (NOUN) Senior Management

Questionnaire B was filled in by the Vice Chancellor and Deputy Vice Chancellors (Academic), and interviews were conducted with Senior Management. The key findings are as follows:

- Nigeria as a country has a national regulatory authority or agency for quality assurance and accreditation of higher education and training, which includes ODL and e-learning. Based on the knowledge and practical experiences/interactions with the national regulatory authority or agency for quality assurance and accreditation in the country, the National Universities Commission (NUC) oversees all the universities in the country, of which the National Open University of Nigeria (NOUN) is one of them. The NUC ensures that quality programmes and staff is maintained. The body embarks on site visitation and supervision among others to ensure effective and efficient curriculum nationwide.
- The tools used by NUC include the eligibility of programme, scope of ODL activities (academic), disciplines to be taught, entry requirements, students delivery mode and staffing issues. NOUN is not aware of how the tools/instruments were developed, certified and adopted for use (i.e. the process), and who was/were involved (i.e. people, institutions or organizations). NOUN is required to have the following types of accreditation:
 - Institutional accreditation
 - Programme accreditation
 - Course accreditation
- There are no major challenges that the national regulatory framework and policy (including tools, instruments and processes) pose to the development and promotion of ODL and e-Learning, both at national, institutional and individual level. Indeed, there are key challenges which developments in ODL and e-Learning pose to national regulatory authorities and frameworks in the country specifically and in Africa generally.

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- There have been, and still are, moves towards establishing, developing and promoting regional and continental quality assurance and accreditation frameworks for ODL and e-Learning. This will ensure quality collaboration among ODL institutions. The greatest impact of the national regulatory framework for ODL and e-Learning on access, skills development, employability, mobility of graduates and sustainable development is on Quality Assurance.

National Open University of Nigeria (NOUN) Students and Alumni

The key responses from the 5 NOUN Students and Alumni are as follows:

- The NOUN students and alumni enrolled with NOUN to improve themselves academically and improve on the career path progression. All the respondents were aware that Nigeria has a national regulatory authority or agency for quality assurance and accreditation of Open and Distance Learning (ODL), including e-Learning. All respondents indicated that indeed NOUN has put in place strategies or mechanisms that encourage or ensure key stakeholders in the institution access, read and/or engage with the document(s) used. There is no complain or reservation about the appropriateness of the policies, procedures and practices that the national regulatory authority or agency for quality assurance and accreditation employs and carries out, with respect to ODL.
- The students and alumni have not felt discriminated against in any aspect, by virtue of the fact that they are graduates of an ODL institution or programme instead of a graduate of a residential face-to-face institution. All the respondents were not aware of any other national policies for higher education and training in the country that are discriminative or unfriendly to ODL students or graduates. The students and alumni of NOUN recommended a way forward in addressing ODL challenges.
- The students and alumni support the establishment of continental frameworks (including standards, tools and instruments) for quality assurance and accreditation for ODL and e-Learning. The reasons include the need to improve the general quality of education in Africa to enable them compete with their counterparts elsewhere in the world; establishing continental assurance accreditation and frameworks for the promotion and development of African ODL programmes; and that each country in the continent will be able to recognize the respective qualification and its authority. It is envisaged that this will further increase the knowledge and skills of the students continentally and enhance students mobility globally.

National Universities Commission (NUC) Executive Management

- The NUC, as the national regulatory, provides accreditation of 117 universities at institutional, programme and course levels. This is the same for Open and Distance Learning (ODL), including e-Learning. The official instruments/ document(s) in which the national regulatory framework for quality assurance and accreditation of Open and Distance Learning, and e-learning uses includes the Instruments for Accreditation (1 conventional and 2 ODL), self study by universities, a manual of accreditation procedures with all instruments and programme evaluation form, and academic centre requirements. Accreditation standards are set with minimum standards required for each institution. Quality Assurance is viewed as a way to promote standards and to ensure safety with minimum academic standards.
- According to Ramon-Yusuf (2011), the Nigerian National Policy on Education has over the years recognized the place of open and distance learning in achieving life-long education and affirms that life-long education shall be the basis of the nation's education policy. Ramon-Yusuf (2011) further contends that the goals of open and distance education are to:
 - Provide access to quality education and equity in educational opportunities for those who otherwise would have been denied;
 - Meet special needs of employers by mounting special certificate courses for their employees at their workplace;
 - Encourage internationalization especially of tertiary education curricula; and
 - Ameliorate the effect of internal and external brain drain in tertiary institutions by utilizing experts as teachers regardless of their locations or places of work. (NPE, 2004).
- However, a critical appraisal of the scope of ODL at any level of education in Nigeria reveals a glaring mismatch between policy and practice. The reality in the Nigerian university system is that there is need to distinguish between open learning and distance education. True openness especially in terms of entry requirement is to be considered a longer term objective against the

backdrop of the reality in the nation's university education scenario which is characterized by perennial mismatch between the demand and supply side of the access equation. The current situation is that there are thousands of young qualified candidates seeking university admission who cannot be absorbed into the nation's universities. The National Open University of Nigeria (NOUN) is currently the only Uni-mode University mandated for Open and Distance Learning in the delivery of university education. There are about six universities which may be regarded as dual- mode universities with limited capacity to deliver degree programmes by the open and distance learning (ODL) mode in addition to the conventional face-to-face mode. All stakeholders agree that the practice of distance learning by these dual mode universities is far below acceptable best practice and that at best, they are in transition from the running of part-time/sandwich courses to distance learning.

- In order to bring the practice of the distance learning up to speed with global practice, it is incumbent on NUC as the statutory quality assurance agency in the Nigerian university system, to streamline the practice of distance learning by stipulating a code of good practice. Such a document should clearly enunciate performance standards pertaining to the entire gamut of teaching and learning by the ODL mode including learner support which is a critical success factor in open and distance learning. Cognizant of the need to contextualize the applicability of the various ODL delivery modalities, the ODL mode shall not be applicable to academic disciplines in a university that does not have capability for that discipline. In view of the nation's present technological and infrastructural challenges, the academic disciplines which may be offered by the ODL mode within the short to medium term (2009-2015) are in fields such as Education; Administration/ Management Sciences; Social Sciences; Arts/Humanities and Sciences and Applied Sciences.
- All entrants into degree programmes offered by ODL must meet the minimum national requirements for university registration. For all academic programmes to be taught by ODL interactive texts shall be at the heart of teaching and learning. These shall be supplemented with other resources such as CDRom, DVD or USB sticks to deliver, e-books, simulations, assessment, etc. ODL means that students should not be required to attend classes or have face to face contact, unless there are compelling reasons to justify it, such as examinations periodic facilitation and practicum. ODL programmes shall be predicated on a pedagogy that is led by resources and not reliant on face to face intervention. Students should be able to register to study anywhere in Nigeria or any part of the world with a common standard of service at any study centre. The study centre should offer both academic and social support. Study centers should act as the focal points of learning communities and have agreed standards of accommodation in facilities and equipment. Students should be expected to be able to have access to ICT to assist their learning. For specific programmes, functional internet access would be required for all study centers. Assessment will include continuous assessment (a minimum of one marked assignment for each 40 hours of study) as well as summative assessment, e.g. exams, portfolios, that provide for validation of achievement. It is expected that assessment tasks will occupy a minimum of 10% of study time. The course score should depend on both the continuous and final assessment. Loading on staff may be reduced by the use of automatically marked ICT based Assignments.

In conclusion, NUC requires the compliance on the following broad areas with respect to ODL:

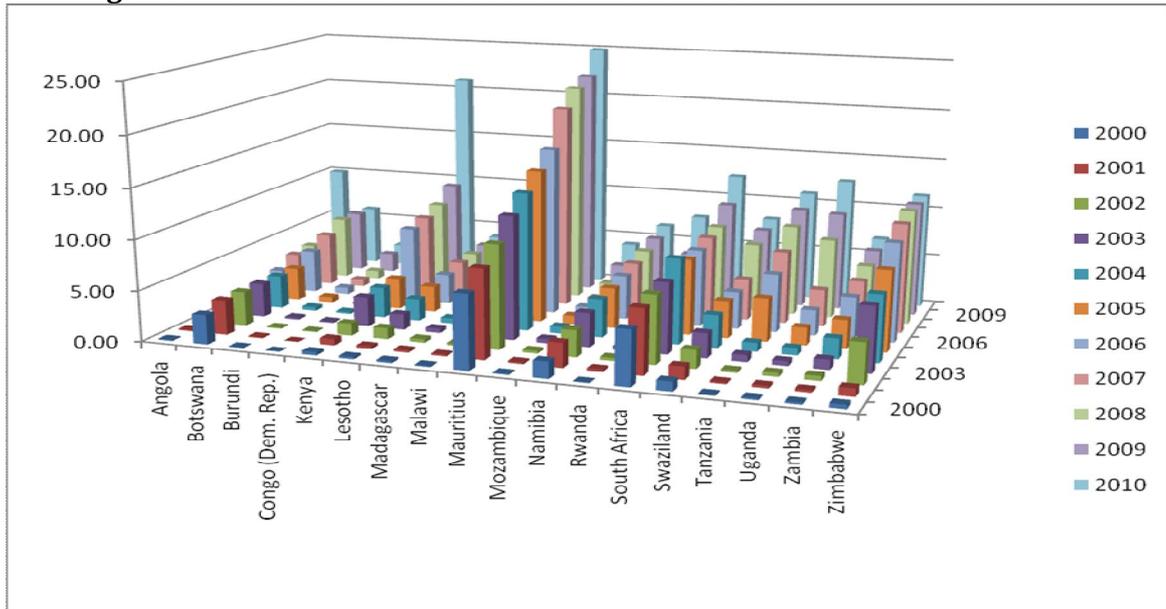
- **Philosophy (e.g. Accessibility; Flexibility and; Lifelong learning)**
- **Objectives of the programme**
- **Admissions to meet** the minimum national requirements for university admission.
- **Curriculum to be streamlined with clarity**
- **Pedagogy with well defined learning objectives**
- **Learning resources should be tailored to ODL**
- **Staffing should be adequate and suitably qualified** for programme leadership, resource and assessment generation, and tutor monitoring.
- **Academic learner support should have** have adequate tutor: student ratio, normally, 1:50, etc.
- **Information, advice and guidance IAG** should be consistent with institutional policy and learner support framework that reflect national policy and best practices.

- **Administrative support for academic programmes**
- **Efficiency.**

ICT Developments in Zimbabwe and Southern Africa

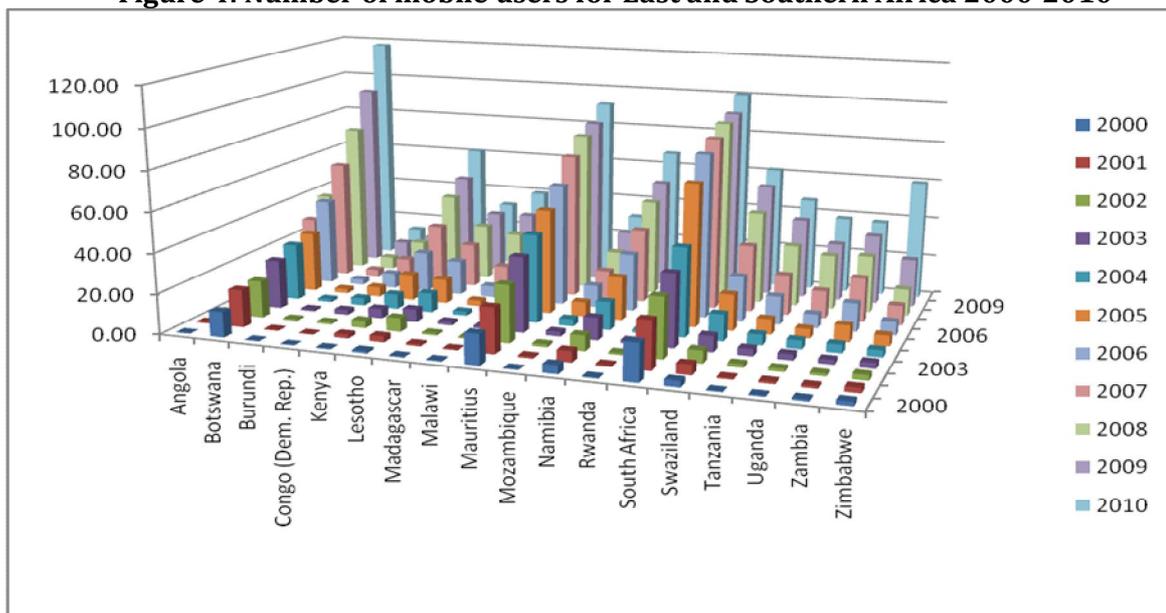
Data on infodensity was obtained from the International Telecommunications Union (ITU, 2011, <http://www.itu.int/en/publications/>), and the analysis is shown below on figures 3-4. The number of internet users per 100 inhabitants (%) by country for the 18 East and Southern African countries were analysed for the period 2000-2010 are shown on Figure 3. Mauritius has the highest number of internet users per 100 inhabitants (%) followed by Kenya and South Africa. Zimbabwe has about 10% internet penetration rate.

Figure 3: Number of internet users for East and Southern Africa 2000-2010



The number of mobile users for the 18 countries for the period 2000-2010 is shown on Figure 4 below. Botswana has the highest mobile density followed by South Africa and Mauritius. The mobile density of Zimbabwe more than doubled from 24% in 2009 to 60% in 2010.

Figure 4: Number of mobile users for East and Southern Africa 2000-2010



The mobile density for Zimbabwe is now at about 62% as at March, 2011. The mobile density for Zimbabwe has risen astronomically between 2008 and 2010, and has one of the highest growth rate

for mobile density among the 18 countries. This tremendous growth in ICTs is conducive for supporting e-learning.

CONCLUSION

There is an increase in public accountability for higher education thus compelling institutions to demonstrate quality within the programmes and processes, including those provided online. The University's vision and mission statements set out its aims for providing a high quality student learning experience. The University's Quality Assurance Framework supports these aims and objectives by specifying the responsibilities and procedures by which the standards of the academic programme and the quality of the student learning experience are managed, assured and enhanced.

The National Universities Commission (NUC) regulates a total of 117 Universities countrywide and provides accreditation at institutional, programme and course levels. Quality assurance is monitored to promote standards and ensure safety with minimum academic standards. The National Open University of Nigeria (NOUN) is currently the only Uni-mode University mandated for Open and Distance Learning in the delivery of university education. NOUN supports the establishment of continental frameworks (including standards, tools and instruments) for quality assurance and accreditation for ODL and e-Learning. This will ensure quality collaboration among ODL institutions. The greatest impact of the national regulatory framework for ODL and e-Learning on access, skills development, employability, mobility of graduates and sustainable development is on Quality Assurance. The students and alumni support the establishment of continental frameworks (including standards, tools and instruments) for quality assurance and accreditation for ODL and e-Learning. Establishing continental assurance accreditation and frameworks will improve and promote development of Africa Open Distance Learning. However, NUC should be more actively involved in helping universities remedy identified deficiencies in their programmes by canvassing for the provision of requisite funds and resources for "special needs" programmes and/ universities.

The regulatory authority of Nigeria, NUC, has one of the best regulatory frameworks in the world that promotes quality ODL programmes. Zimbabwe Open University (ZOU) can learn through adaptation and customization of the experiences of Nigeria to Zimbabwe. The ICTs developments in Zimbabwe show one of the fastest growth rates in Africa and is conducive for e-learning. It is feasible that Materials Science education can be taught in Zimbabwe through ODL and e-learning, guided by the best practices and experiences of Nigeria. The AVU experience is worthy of consideration. However, courses on Nanotechnology would require extensive use of ICTs, especially in computer graphics and animation.

ACKNOWLEDGEMENT

The author would like to sincerely thank the African Council for Distance Education (ACDE), through its Executive Director, Professor Fred Barasa, for sponsoring the research work.

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