

Strengthening the Teaching of Practical Science in Open and Distance Learning and Establishing a Sustainable Culture of Applied Research at the Faculty of Sciences of the National Open University of Nigeria

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Abstract

The National Open University is the premier single mode Open and Distance Learning (ODL) university in Nigeria and a leading one in terms of student population in Africa. It has about 420,000 students spread across 78 Study Centres in the Federal Republic of Nigeria. The Faculty of Sciences (FOS) is one of eight faculties at the National Open University of Nigeria. The FOS has an average of 75,000 registered students but few full-time academic staff members with high student-staff- ratio. This makes administrative workload of academics heavy while international best practices need to be integrated into teaching and learning. Research activity was largely skeletal in the Faculty because of these challenges. My Project Action Plan (PAP) explored avenues to ensure international best practices in teaching and learning of practical science in the Faculty that would give distance learners hands-on practical experience and make them more competitive in the labour market. It also sought to entrench the culture of applied research in both ODL and conventional research among academics. It was expected that these activities would also enhance the visibility of the National Open University of Nigeria in science capacity building and national development through research. To achieve these goals, key tasks and expected milestones were defined for the two categories; teaching and learning, and research. At the end of the project, nine interactive laboratory practical manuals were developed for practical sessions in B.Sc. Biology, B.Sc. Chemistry and B.Sc. Physics programmes. Demonstration videos for the nine manuals were also made. The Faculty Board prepared an integrated proposal that incorporated these materials, hands-on laboratory practical session, and mobile laboratory options with digital approach such as virtual laboratory and simulations as a multimodal package for practical science at the National Open University of Nigeria. This formed the concept which the Faculty presented to the university and the university eventually adapted for the World Bank funded Africa Centre of Excellence (ACE) development impact project, which eventually was among the ten new ACE in Nigeria conditionally nominated by the World Bank. A culture of research was established through research workshop, seminars, research

proposals grantmanship, showcase of research products, increased number of publication by academics in the Faculty and presentation of research results at conferences, institution of Faculty/university publications and strong rewards system defined.

1 Introduction

The National Open University of Nigeria (NOUN) in Perspective

The National Open University (NOU) was established on 22nd July, 1983 by Act No. 6 of the National Assembly of Nigeria in alignment with the 1977 National Policy on Education (NPE), which emphasized unambiguously that the Federal government shall make maximum efforts to enable those who can benefit from higher education to be given access to it. Consequently, NOU was to provide alternative mode of education that would ensure that all Nigerians who desire quality education can readily access it without any barrier while fostering national cohesion.

The NPE explicitly referred to what is now known as Open and Distance Education (ODE), a system that encompasses education for all, for life, life-long learning, life-wide education, adult education, mass education, media-based education, self-learning, part-time studies, etc. It is this policy that forms the bedrock of the National Open University (NOU). However, the university was closed down on 25th April, 1984 by the Federal Military Government that overthrew the civilian government of Alhaji Shehu Shagari.

Many years after the closure, the reasons that informed the earlier establishment of the University still confronted the country (NOUN, 2012). Other reasons that had also emerged included the need to fill the vacuum created by the closure of profit-oriented outreach programmes of many conventional universities in the country; the need for cost effective funding of education; and the need to take advantage of emerging developments in the field of information and communications technology (ICT), which had revolutionised the techniques and methods of instructional deliveries. Consequently, in 2002, the democratic administration of President Olusegun Obasanjo lifted the suspension of National Open University Act No. 6 of 1983. This flagged the restoration of the university, now popularly referred to as the National Open University of Nigeria (NOUN).

UNESCO (2002) describes Open and Distance Learning (ODL) as approaches that focus on opening access to education and training provision, and free learners from the constraints of time and location, thereby offering flexible learning opportunities to individuals and groups of learners. In line with this, the NOUN seeks to be regarded as the foremost university providing highly accessible and enhanced quality education anchored by social justice, equity, equality and national cohesion through a comprehensive reach that transcends all barriers. In order to achieve the vision, the mission statement is to provide functional, cost-effective, flexible learning which adds lifelong value to quality education for all who seek knowledge.

The National Open University of Nigeria has 78 Study Centres spread across Nigeria. There are eight Faculties namely Faculty of Agricultural Sciences, Faculty of Arts, Faculty of Education, Faculty of Health Sciences, Faculty of Law, Faculty of Management Sciences, Faculty of Sciences and Faculty of Social Sciences. In addition, there is a School of Postgraduate Studies (SPGS).

National Open University of Nigeria's Strategic Commitments

National Open University of Nigeria makes use of a multi-modal instructional system, which takes cognizance of the local environment, and consists of a variety of such media and technologies as audio, video, radio, television, computers, VCD, DVD, CD-ROMs, and the Internet (web-based instruction) that the learner is already familiar with or can be made easily available to him/her (NOUN, 2012).

Strategic Aims and Objectives of the National Open University of Nigeria

The strategic aims and objectives of the National Open University of Nigeria as defined by its unpublished Strategic Plan 2013–2017 (NOUN, 2012) include but are not limited to:

- a) Provide high quality learning materials and opportunities using the most appropriate, relevant and cost-effective learning and instructional media and technologies and support services, and continually seek to improve the quality of our courses and services;
- b) Collaborate with institutions and organizations within the West African sub-region for training and development in ODL through the activities of Regional Training and Research Institute for Open and Distance Learning (RETRIDOL); and enhance the growth and development of NOUN and its staff through partnerships with International Development Partners and professional organizations and other open and distance institutions worldwide such as Commonwealth of Learning (COL), the United Nations Educational, Scientific and Cultural Organization (UNESCO), African Council for Distance Education (ACDE), University of South Africa (UNISA), Indira Gandhi National Open University (IGNOU), among others;
- c) Develop materials suitable for international students beginning with West Africa through the African region to the rest of the world in keeping with the trend in cross-border education and the need for NOUN to have an international presence in ODL;
- d) Institute and nurture an ODL research culture at NOUN, engage in purposeful, contemporary research and scholarship that affect daily operations of ODL at NOUN and, disseminate the research results that will launch NOUN as a research oriented open university;
- e) Maintain a financially sound and stable institution through the attraction of funds from government and agencies (external and internal), required to realize all the critical objectives of the University;

- f) Sustain and increase the professional development of staff to meet the needs of an emerging open university to deliver quality education through flexible learning; and
- g) Ensure that learners have value for their investment in all our services as contained in the service delivery charter of NOUN.

To achieve its goal, NOUN promotes collaboration and partnership with both national and international institutions, organizations and agencies globally in order to foster team work, sharing of ideas and resources and develop professionalism. The institution also recognises that well-trained, motivated and committed staff members are our key assets and is therefore committed to their continuous professional development and the provision of necessary welfare and reward to engender loyalty and hard work (NOUN, 2012). My project action plan (PAP) for ensuring the teaching of practical science and perennial research in the Faculty of Sciences leveraged on the selected strategic aims and objectives enumerated above. The PAP is within the strategic goal of the university.

Faculty of Sciences; Identifying Gaps

Currently, NOUN is the only single mode university effectively operating on ODL mode in Nigeria and the West Africa sub-region. Even though there is still high scepticism about the teaching of practical science through the ODL mode, this has not deterred the university from mounting programmes in natural and physical sciences, which often require hands-on laboratory practical training. The implication being that provision needs to be made to ensure that learners acquire the necessary skills that would make them competitive with their counterparts from the conventional university system.

Gap analysis provided by the university-wide strategic document (NOUN, 2012) guided decisions on actions and strategies taken to achieve defined aims and set goals of the project action plan (PAP) reported here. Some of the weaknesses identified included poor work ethics and high workload of academics, inadequate human resources in terms of skills and population size, as well as poor research, and teaching and learning infrastructure for natural and physical sciences at the National Open University of Nigeria. A major opportunity identified is Information and Communication Technology (ICT) to drive the ODL mode.

2 Appraisal of the Current Situation with Teaching of Practical Science and Research at the Faculty of Sciences

Faculty of Sciences has four Departments, namely, Department of Computer Science, Department of Environmental Sciences, Department of Mathematics, and Department of Pure and Applied Sciences all running Bachelor degree programmes with Department of Computer Science additionally running postgraduate Diploma

(PGD) and M.Sc. programmes. Student enrolment in the Faculty of Sciences is about 75,000 and close to 25,000 of these is active on semester basis. This accentuates the challenge of administering practical science in the ODL system. There are 41 full-time academic staff members in the Faculty, a quarter of which are either away on study leave or leave of absence and more than 300 part-time academic staff members who serve as Facilitators spread across the 78 Study Centres of the university. Four of the full-time academic staff members of the Faculty were re-deployed as Centre Directors to some of the Study Centres. This re-deployment is done by University Management across the faculties from time to time as the need arises.

Students largely receive courseware/course materials (Harsha, 2017; Anaekwe & Nnaka, 2017), which they study at their convenience and they have the opportunity of having a reduced period of face-to-face contact with Facilitators at their respective Study Centres. However, there were no manuals for laboratory experiments as it was generally conceived at the establishment of the university that students would take laboratory practical classes at partner institutions with which agreement was signed. However, these universities were few at the inception of NOUN. As science programmes were established and students enrolled into them across the country, it became clear that the existing arrangement was inadequate for professional laboratory based science programmes, more so that the population of students of the Faculty is larger than that of the partner institutions and this was always tasking on their facilities.

Also, a general practice had been that Facilitators (part-time tutors who hold tutorial classes with students at their designated Study Centres) allow students to undertake practical classes in the laboratory facilities of their own primary institutions informally. The implication of this is that it may be done infrequently and would be at the convenience of the Facilitator. Furthermore, activities are not streamlined or standardized across the Study Centres. In some cases, students may not even have the opportunity to take any hands-on science practical. Another option explored by the university is to prepare certain practical course curricular with course materials prepared in a way to provide “alternative to practical” training. In this case, the lack of hands-on practical exposure is partly made-up for by the policy of Student Industrial Work Experience Scheme (SIWES), which learners undertake in the third year of a four year programme. However, SIWES cannot always erase the need for definite laboratory hands-on practical experiments.

Although strategic commitments of NOUN stipulate multi-media and multi-dimensional training facilities, it is preferred that students receive hands-on training in practical science. However realizing that the practicality of this is a tall order because the Study Centres do not have the infrastructure required, it became necessary to clearly define how learners would gain access to hands on practical facilities. Open and distance universities in some developed countries adopt “kitchen science” or its variant in which case learners are able to, with guidelines, carry out some experiments at home, using domestic kitchen facilities for basic non-professional practicals and designed home laboratory kits for professional training (Lyall, and Patti,

2010). Home laboratory kits for first level science training may work well in developed countries. However in developing countries like Nigeria, where funds are limited for many learners to acquire basic home safety gadgets/facilities, adopting “home laboratory” would be a challenge. The most immediate option would be to partner with sister universities with agreement to allow NOUN learners use their existing laboratory facilities.

In order to strengthen pedagogy, it is necessary that we satisfactorily identify need to up skill and new skill requirement of instructors (Mayer and Wilde, 2015). Conferences, seminars and training workshops are panacea for short-term skills acquisition. Partnership with sister institutions and staff exchange would help strengthen skills of academics. It is expected that such relationship with sister ODL institutions, for example, would help strengthen skills of academics at NOUN.

3 Project Action Plan

The Project Action Plan (PAP) was an instrument of the International Deans’ Course (IDC), which I employed to intervene in the challenges described above. There were five general objectives of my PAP namely: (1) to ensure that students are adequately exposed to science practical training in the open and distance learning (ODL) system, (2) to strengthen skills of academics in preparing learner-friendly learning materials, (3) to stimulate interest in applied research and allow academics to earn from their products, (4) to encourage research collaboration/partnership internationally and, (5) to enhance the visibility of the National Open University of Nigeria in capacity building and national development through research.

Intended outcomes of the PAP:

Certain expectations are anticipated from my PAP and they are given below:

1. Memoranda of understanding between National Open University of Nigeria and 36 selected universities in Nigeria for laboratory practical,
2. Multimedia materials (CD, online video, etc.) for science practical demonstration and teaching would be developed,
3. MoU with universities in the global north (especially ODL institutions) for access to Virtual laboratory facilities as well as other learning and research facilities,
4. Interactive practical course materials would be developed and collaboration with other ODL institutions on course material development established,
5. Products of science research would be available for showcasing at different fora,
6. Increase in number of publications in high impact factor journals,
7. Increase in number of faculty members presenting their research results in local and international conferences, hence,
8. Patents would be registered and subsequently, increase in number over time,
9. Research and Development Roadmap (Strategic Plan) 2018–2023 would be available for the Faculty,

10. Philanthropists and industries support faculty research drive,
11. Increased mobility of academic staff in the faculty and internationalization,
12. Increased number of grant winning proposals and development-focused applied research
13. Better visibility and enhanced advocacy for NOUN

Potential risks to be taken into account on the project:

Likely threats to the success of the PAP that were taken into account included: (1) University Management position on certain proposals, (2) the challenge of size of the country and coordination of student practical in Open and Distance Learning terrain, (3) possible conflict of interest with some other units in the university responsible for academic planning and research coordination, (4) limited funds for research and execution of PAP, (5) limited time for research due to heavy academic and administrative workload of academic staff, (6) poor motivation of academics for high impact, ground-breaking research due to poor research infrastructure, (7) delay in processes due to bureaucratic bottlenecks.

4 Strategic Actions Taken to Achieve the Set Goals and Ensure Intended Outcomes

Building Awareness for the Project Action Plan

Stakeholders were sensitized on the plan for enhanced teaching of practical science in ODL and the need to develop a culture of applied research at the Faculty of Sciences of the National Open University of Nigeria. The Vice-Chancellor, being the Chief Executive Officer (CEO), was presented with the plan and he pledged support for it. Consequently, at intervals, the plan was presented to the Faculty Management comprising of the Dean, Deputy Dean and Heads of Departments as proposed Faculty activities for discussion before presenting to Faculty Board for consideration. The Board set up committees for the different aspects of the plan at different times and mandated them to draw up action plans and submit for further deliberations at subsequent meetings. It is necessary to note that the project action plan was presented to the Board subtly in a manner that they could identify with it yet they do not see it as the Dean's project that must definitely be achieved. This strengthened the team spirit and made all have a sense of ownership of the project.

The Project Action Plan (PAP) is divided into two major studies; (a) Strengthening the teaching of practical science in Open and Distance Learning (ODL) and (b) Establishing a sustainable culture of applied research. They are so reported under the two sub-themes.

A. Teaching and Learning

1. Explore Opportunities For Partnership With Developed Institutions In The Delivery of Practical Science In ODL And Capacity Building/Training of Academic Staff

Colleagues in the Science, Technology, Engineering and Mathematics (STEM) Faculty at the Open University, UK (OU) initiated contact with me via our website details and we built the relationship mutually. It resulted in an invitation of three academic staff members of NOUN and the Faculty of Sciences to a workshop in the preparation of joint proposal with STEM Faculty. I made presentations on the challenges of practical science training in NOUN at the workshop. I was also invited to deliver another paper in the Open University-Grand Challenge Funds Research (OU-GCFR) workshop on my experience with North-South partnership. My presentation at the GCFR workshop attracted partnership with another professor who had collaboration with University of South Africa (UNISA) and had wanted to explore South-South collaboration of South Africa with Nigeria on their project. Discussion was thus initiated with University of South Africa – Open University (UNISA-OU) network. This also led to a proposed workshop to train academics in the Faculty of Sciences at NOUN in teaching practical science for ODL. Although partnership was secured in principle with STEM faculty of the Open University (OU), an agreement could not be signed at that point. However, report was presented to the Vice-Chancellor upon return to the office and work is ongoing regarding finalizing and implementing the agreement.

2. Plan And Host Training Workshop On Evaluating Learning Design In Blended And Online Courses

Academic staff members of the Faculty of Sciences in NOUN were to be trained in a one-day workshop on evaluating learning design in blended and online courses, facilitated by the UNISA-OU team organized by and administered at the National Open University of Nigeria. However, this was up-scaled by Management to a university wide-affair for the training of Management teams of faculties: Deans, Deputy Deans and HODs, as well as Directors of academic units. This meant that the training ended up being a train the trainer workshop and was expected that the trained would return to train other colleagues in their faculties.

3. Ensuring Hands-On Science Laboratory Practical Exposure For Undergraduate Students

3.1. Science practical scores:

A first step was taken to secure approval of the University Senate to incorporate science practical scores in the final score of learners for each course with practical component. This approval had been secured in December, 2016 before the commencement of the PAP. This done, the drive for practical skill acquisition began because the approval gave it legitimacy.

3.2. Development of Learning Materials (Laboratory manuals and videos):

There had not been any concerted effort to prepare laboratory manuals for science students largely because often times, the students were guided by facilities where the facilitators take them for the laboratory experiments or the few institutions with which NOUN had documented agreement at resuscitation of the university utilized their own laboratory manuals. That implied that the students were exposed to varying experimentations. In order to ensure uniformity and properly define curriculum, the Laboratory Committee was charged with the responsibility of developing learner-friendly science practical manuals for hands-on science practical. So far, laboratory practical manuals have been produced for nine courses spread evenly across B.Sc. Biology, Chemistry and Physics programs. Complementary videos were also produced for each of the nine courses. The videos are undergoing formatting so they could be mass produced on discs and as well uploaded to the Learning Content Management System being developed by the university.

3.3. Partnership with sister universities

The next move was to ensure that student practical sessions were correctly and effectively coordinated across the nation with manuals already available for use. It looked like the most practical thing at that time was to negotiate agreement with other universities within close neighbourhood of some designated Study Centres, particularly major ones located in state capitals. The Laboratory Committee went to work to map out a reasonable strategy that would be effective. Eventually, 36 sister universities were selected spread across the six geopolitical zones of Nigeria; North Central, North East, North West, South East, South-South and South West, to ensure that students undertake hands-on laboratory practical across our Study Centres. Study Centres were grouped within these six regions across the 36 selected sister universities. Academic, Laboratory Technologists and administrative staff members in the Faculty were grouped into six to cover universities within their assigned regions with each team having a complement of the three categories of staff where feasible. Each team was led by a senior academic and the administrative staff in each team served as Secretary to the team to cover proceedings of negotiations in each university visited. Each team visited the universities within their assigned region and presented a consolidated report after the visits. Summary report with cost implication of financing student laboratory practical across the 36 universities was presented to the Vice-Chancellor for university management's decision. Several universities were willing to partner with NOUN but the huge total cost implication was a deterrent to concluding the negotiations and signing the MoUs by NOUN's university Management. Consequently, University Management is exploring other options that would allow limited funds available to be used to develop own facilities, which would be more cost effective. An example is six regional well developed (equipped) laboratories across the country,

3.4. Commencement of science practical sessions in two of phased regional laboratories

Since the signing of the MoUs was delayed, the Laboratory Committee decided to explore the regional laboratory intervention option. A proposal was made for certain additional equipment and consumables to be procured in order to enable laboratory practical hold effectively in our set of laboratories in Lagos and a mobile set arranged for Abuja. However, a six regional laboratory set was proposed. The two regional laboratories out of six were proposed as mid-term intervention by the Faculty of Sciences. The proposal to hold practical sessions in Abuja received approval of the Vice-Chancellor and was subsequently funded. This made it possible for laboratory practical sessions to be held in Lagos and Abuja consecutively between 2017 and 2018. Consequently, two regional laboratories were already defined and functional.

B. Research

In this section, I shall now focus on key tasks that I embarked upon in the drive to establish a sustainable culture of research in the Faculty of Sciences. Please note that the Faculty system was newly created in the university in July 2016 and certain basic faculty structure and function were lacking. It was then necessary to streamline activities and define a clear structure and function within the provision of university policy.

1. Reduce Workload of Academic Staff in Order to Allow More Time for Development-focused Research

In order to ensure that academic staff members have more time for research work, it is necessary to ensure that their heavy administrative workload is reduced. This could be achieved by either recruiting more full-time academic staff or out sourcing to part-time academics. Effort was made to recruit additional academic staff for the Faculty of Sciences within the provision of university management's policy. A total of nine additional academics were appointed for the Faculty but only eight assumed office between November, 2017 and March 2018. Of these, one was on a one year contract, which has lapsed and another tendered his resignation shortly after assumption of duty due to the too heavy work burden in the system compared with the conventional institutions in Nigeria. With university management's approval, certain tasks were out-sourced to resource persons/consultants who are professors in the various science disciplines from sister universities across the federation and on part time appointment with NOUN.

2. Define Research focus for the Faculty and Stimulate Interest in Applied Research among Academics

Research focus was defined for the Faculty and coordinated by the Research and Seminar Committee for the Faculty while a report of the research focus of the Faculty

was submitted to the university's Directorate of Research Administration and Advancement. Research goals were set and strategies for achieving set goals were mapped out; plans for execution and regular monitoring were put in place through the development of a strategic plan (2018–2023) document prepared by a Faculty Strategic Plan Committee set up for the purpose. The Faculty's Strategic Plan 2018–2023 was presented to the Faculty Board, updated afterwards based on observations of the Board. A final copy was delivered by the Committee on the 2nd of February, 2018 and a copy was submitted to the Directorate of Academic Planning of the university.

3. Acquire Research Facilities and Develop Skills of Academic Staff

To ensure perennial research, adequate and standard research facilities and infrastructure need to be provided in the Faculty. Considering the huge financial capital required to set-up a standard functional laboratory, it is clear that University Management may not be able to shoulder the financial burden of setting up extensive laboratories; hence there is the need to explore external sources to support management's efforts. The following activities were proposed to be explored to ensure research facilities were provided and skills of academics for sound research enhanced.

- i. University self-development: This was done progressively by preparing requests for equipment and consumables in phases. This received the approval of the Vice-Chancellor and facilities in the laboratories were populated gradually. Facilities were used for the accreditation of the B.Sc. Biology, B.Sc. Chemistry and B.Sc. Physics programmes and all three programmes received accreditation in different categories; full for B.Sc. Biology and B.Sc. Physics programmes, and interim for B.Sc. Chemistry programme. Approval was also given by the University for the set of laboratories for the natural sciences at the Faculty in Abuja to be appropriately furnished. The contract for the work had been issued by University Management following due process and the contractor had moved in to work to hopefully complete the job by end of November as he estimated.
- ii. Project Funding: University funds short-term research, for example for the exhibition of Federal Ministry of Science and Technology (EXPO' 2018). Based on the recommendations and experience of the Faculty of Sciences at the 2017 EXPO, the university set up a central committee for three proposed faculties' participation, to plan for EXPO' 2018. The proposal of the Faculty of Sciences received approval of the Vice-Chancellor who advised the budget to be reviewed downwards. Consequently approval for funding rolled over to 2019 EXPO. Products from research were developed and research results packaged.
- iii. Philanthropists and endowments: Philanthropists and organizations who could endow facilities were identified. An attempt made with a government organization, Nigerian Meteorological Service (NIMET) succeeded. The Director General (DG) of NIMET promised to endow a Weather Station and the Faculty followed up with the Vice-Chancellor who officially wrote a request in support of this move to the DG who promised to facilitate the provision.

- iv. Postgraduate programmes mounted: This is expected to encourage long term research in the Faculty.
 - a) Department of Computer Science prepared the curriculum for Ph.D. Information Technology programme, presented it for Faculty's Postgraduate Board's consideration. Updated document was submitted to the School of Postgraduate Studies (SPGS) Board's curriculum committee for evaluation and was presented to Senate through the Directorate of Academic Planning on the recommendation of the SPGS. The PhD curriculum for Information Technology received Senate approval in 2017 December.
 - b) Curricula for M.Sc. and Ph.D. programmes in Mathematics department were submitted to Faculty's PG Board for first consideration. The M.Sc. programme curriculum had been updated by the Department and re-considered by Faculty's PG Board, which had recommended it for submission to the Curriculum Committee of the Board of the School of Postgraduate Studies (SPGS). This had since been done and is awaiting SPGS's recommendation to Senate through the Directorate of Academic Planning (DAP).
 - c) Other Departments that have graduated at least two sets of students have been advised by the Faculty's PG Board to commence preparation of M.Sc. and PhD curricula.
- v. A software laboratory was established in the Faculty in Abuja while Lagos Liaison office has got a laboratory space yet to be furnished. A budget for furnishing has been sent to university Management and it is hoped would receive approval soon.

4. Establishing a Culture of Applied Science Research in the Faculty of Sciences

This was done through the following strategic actions:

4.1. Faculty Publications and Research Products

- i. The Faculty Board recommended that Proceedings of the Annual Faculty Seminar be published and this has also received the approval of the Vice-Chancellor
- ii. An annual public lecture would be published when it holds in April, 2019;
- iii. Proceedings of annual Faculty week would also be produced for the Faculty week when it holds in 2019 as very busy university calendar could not accommodate a planned Faculty week in 2018.
- iv. Instead of a Faculty Journal, the University Management approved a harmonized journal jointly produced with Faculties of Agricultural Sciences and Health Sciences. However, the Dean, Faculty of Sciences is serving as pioneer Editor-in-Chief and the Faculty of Sciences as the secretariat.
- v. Ten innovative research products of academic staff members of the Faculty were developed and shall be showcased during the 2019 exhibition of science and technology innovations of the Federal Ministry of Science and Technology (FMS&T) tagged EXPO'2019 in January 2019. The FMS&T organizes an annual

exhibition of science innovation to encourage uptake of research result by the industry and networking among institutions. Higher institutions, research stations, government parastatals and industry are invited to participate in the EXPO. Institutions are also connected with Government agencies that handle intellectual property rights and patent.

- vi. The Faculty's EXPO' organizing committee proposed honoraria to be given the exhibitors from the Faculty in item v above and it is proposed that university would patent the products afterwards.

4.2. Seminars, workshops and conferences, public lectures and faculty week

The Faculty organized monthly seminars with calendar of activities drawn up to ensure that contributions are received from the four Departments at least three times in a year. On 20th March, 2018, the Faculty organized a one-day workshop on academic matters and one on administrative matters on 21st March, 2018 to review academic and administrative processes in the Faculty with a view to re-structure where appropriate in order to increase delivery effectiveness and efficiency. The Faculty also organized a one-day research workshop in 2018. The success of the workshop and its resultant action (presented below) informed the approval of funding by the Vice-Chancellor for the 2019 follow-up research workshop.

The Faculty would commence its annual Public Lecture in 2019 to educate the university community and the public on significance on science training in national, industrial and economic development. A Committee was put in place and is already working to plan a research fare/science week in 2019 during which the Public Lecture would feature.

4.2.1. Research Workshop on Grantsmanship:

The Faculty of Sciences held a one-day workshop on accessing research grants and publishing research results held on Thursday 5th of April, 2018.

The Vice-Chancellor, National Open University of Nigeria, Prof. Abdalla Uba Adamu was the Key Facilitator and he challenged the Faculty with his presentation on "Blending Community Science in the Classroom - Hausa Proverbs and Efficacy of Ethnoscience Methodology". It was a call to deploy cultural tools such as ethno proverbs in the teaching of science, particularly in Open and Distance Learning. This, he opined would enhance popularity and uptake of science, and as well as its comprehension. This was a challenge to the Faculty to develop research proposal that would blend Afrocentric and conventional research that would drive technological advancement and industrial development in the country and in Africa. The crux of the workshop was the hands-on session anchored by the Dean, Prof. Monioluwa O. Olaniyi (i. e. myself) on the preparation of research grant proposals; being guided by features of a grant-winning proposal, using the Nigerian Tertiary Education Trust Fund (TETFUND) research grant proposal document as a study document. Other topics were covered by professors in the different Departments of the Faculty and a software company representative who partnered with the Faculty.

The workshop resolutions were drafted in a communiqué and presented to the workshop participants by the Chairperson of the communiqué committee for review before a final document was submitted to the Dean for onward presentation to the Vice-Chancellor. Certificates of participation were awarded to all participants.

4.2.2. The Faculty Call for Research Teams and Concept

The workshop ended with a challenge to form working teams to prepare competitive group research proposals that could be submitted to funding bodies/agencies. The Coordinator of Research and Seminar Committee then set out to define two groups namely environmental remediation working group and digital learning material development group. She called for follow-up meetings for each team to develop research concepts into full blown research proposals in line with successive discussions on prevailing academic challenges of the Faculty Board. Funds had been approved for a follow-up workshop in February, 2019.

4.2.3. Commemoration of World Environment Day, June 5, 2018 and Research Concept

The Faculty of Sciences commemorated the world environment day on June 5, 2018 with the theme “Beat Plastic Pollution” and held a sensitization campaign workshop on “Plastic Pollution and the need to effectively re-cycle”. The need for remediation of the environment and effective management of wastes was accentuated. The University Management was enthused and pledged support for an affirmative action in this wise. Consequently, the Faculty started developing a concept on management of plastic pollution and remediating the environment.

4.2.4. Africa Centre of Excellence (ACE) for Development Research Phase 3: Call for proposal

Shortly after the Faculty’s research workshop, the university received the call for research proposal for the World Bank assisted Africa Centre of Excellence for Development Impact (ACE Impact) Project. This is a World Bank assisted project for 12 participating West and Central African countries; Benin, Burkina Faso, Cameroon, Cote d’Ivoire, Djibouti, Gambia, Ghana, Guinea, Niger, Nigeria, Senegal, and Togo.

The Faculty of Sciences submitted to the university’s Steering Committee for consideration, the concepts that the Board had deliberated on and agreed to. Apart from the Faculty of Sciences submission, no other Faculty in the university came up with any other concept. Consequently, the Steering Committee agreed to adopt the two concepts of the Faculty of Sciences as submissions from the National Open University of Nigeria (NOUN) in response to the World Bank assisted ACE Impact call for proposal. To suit the terms of reference of the call for proposal, appropriate project topics were then calved out for the two concepts as given below:

1. Africa Centre of Excellence for Technology Enhanced Learning (ACETEL)
2. Africa Centre of Excellence for Environmental Remediation and Management (ACEERAM)

The digital concept aspect of the proposal earlier submitted by the FOS Board to the Vice-Chancellor formed the strength of the proposed ACETEL while the FOS Board's concept of cleaning up plastic pollution and waste management formed the basis of the ACEERAM. These project topics were submitted by NOUN in the first phase of the proposal submission process.

4.2.5. Outcome of Africa Centre of Excellence proposals

One of the proposals for the Africa Centre of Excellence (ACE) for Development Impact, Africa Centre of Excellence for Technology Enhanced Learning (ACETEL), eventually succeeded. It is worthy to note that the ACETEL team developed the proposal in line with the Faculty of Sciences' concept and eventually emerged as one of the 26 new universities in West and Central Africa; 10 from Nigeria, whose proposals were conditionally selected as Centres of excellence by the ACE Impact Ministerial Project Steering Committee at its meeting in Accra, Ghana, on Friday, 2nd November 2018.

The ACEERAM team however reviewed the Faculty's concept from the onset and the project title was first changed from ACEERAM to Africa Centre of Excellence on Environmental Degradation Remediation and Management (ACEEDRAM) and eventually reviewed intensively and extensively the final proposal's concept. The concept of plastic waste management and proposed remediation of its resultant pollution, the backbone of the original idea, were removed from the final proposal. This made their final submission to be a sharp deviation from the Faculty's original concept. This may have been responsible for the ACEEDRAM proposal not succeeding.

Although the project had been escalated to university level and hence out of the hands of the Faculty, the Faculty contributed 46 % of the team members of the two teams combined, from proposal development stage till constitution of members of the Centre's Management Boards. This gave the members of the Faculty Board the opportunity to participate in and acquire hands-on experience in grantsmanship.

4.2.6. Other Research Grant Proposals

Research teams have freely formed now in the faculty and academics are now working together in teams. A team of three has recently submitted a research grant proposal for TETFUND, Nigeria from the Faculty. Three other groups are working to come up with sound research proposals.

5. Institute Reward System

Based on Faculty Board's decision, a Faculty Award Committee was set-up and award categories recommended were constituted. Winners emerged in the following categories:

- i. Academic/Scientist of the Year 2017 (1st, 2nd and 3rd positions)
- ii. Best Academic in Administration of the Year 2017
- iii. Best Administrator of the Year 2017
- iv. Best Junior Administrative Staff of the Year 2017

6. Welfare

The project was to strengthen welfare in the Faculty and create healthy work environment in terms of personnel interaction for effective delivery on the job. These were executed as follows:

- i. End of year get together held for the first time in the Faculty
- ii. Awards winners were announced at the function
- iii. Monetary award was endowed by the Dean for first place winners in all categories
- iv. Letters of award were issued by the Faculty and presented to university Management for recognition: Management commended this effort but could not approve its institution because it was not yet a university-wide arrangement
- v. Other celebrations held to let off heat and make the work environment more appealing: e. g. quick birthday celebrations and send-off of staff whose contract had ended (during lunch breaks), mobilizing colleagues to celebrate with members on their joyous occasions and even sad event, giving signed cards as memorabilia on birthdays, send-off, baby celebrations, etc.

Mid-Term Review of my Project Action Plan and Processes

At mid-term, I booked an appointment with the Vice-Chancellor to present update on my PAP to him and to further solicit his support for the remaining part of the plan. The Vice-Chancellor re-affirmed Management's support for my PAP and the remaining workshops, which were pending, such as workshops on academic matters and research, which had been reported earlier in this paper. The journal (NOUN Journal of Physical and Life Sciences) also received approval to be funded for publishing. The mid-term presentation to the Vice-Chancellor helped secure further support, both goodwill and financial, that ensured successful completion of my PAP and other ancillary achievements, which were initially not part of the original plan but which demanded attention while executing the PAP.

Comparative Assessment of Situation Before and After Executing my Project Action Plan

Comparing the situation before and after the execution of my PAP, the effectiveness of the strategic actions could be verified as summarized below.

Whereas only one academic staff was recruited for a one year Sabbatical leave in 2016, by the end of 2017, nine academics spread across three of the four Departments had been recruited but one of them resigned shortly after assumption of duty. In 2018, Management has compiled vacancies declared by Faculties for another recruitment exercise. However, a senior academic was recently spot recruited by University Management for the Faculty and is expected to assume duty in December, 2018. It is expected that many more academic staff would be recruited in line with Management policy in 2019.

Number of Faculty seminars increased by about 167% from 2016 to 2017 but in 2018, no seminar had been held up till September due to the busy university calen-

dar, which made creating time for Faculty regular activities challenging. Notwithstanding, three major Faculty workshops were held in 2018 and an additional Departmental workshop compared to only 1 in 2017.

In 2016, there was no record of Faculty publication but in 2017 after commencement of my PAP, a proceeding of Faculty Seminar series was produced and issues of the harmonized journal, the NOUN Journal of Physical and Life Sciences (NJPLS).

Following the Faculty workshop on writing grant-winning research proposals and identifying acceptable outlets for publishing research results, the Faculty presented 2 research concepts, which were adapted by the university. Furthermore, more academic staff members were promoted based on quality and quantity of research output (Table 1), while a large proportion of academics that did not have a PhD degree are now making moves to do so with 20% already enrolled on their PhD programmes.

Table 1: Promotion of academic personnel into different ranks (based on research publications) between January 2016 and January 2018 across departments in the Faculty of Sciences. (Note that promotion is effective January of every year)

Department	2016 (#)		2017 (#)		2018 (#)	
	Presented	Approved	Presented	Approved	Presented	Approved
Computer Science	1	1	1	0	3	2
Environmental Science	0	0	1	0	2	0
Mathematics	0	0	0	0	2	2
Pure and Applied Sciences	0	0	4	1	4	3
Faculty Total	1	1	6	1	11	7

To strengthen research capacity in the Faculty and build capacity in both professional and ODL applied research, postgraduate programme curricula were encouraged to be developed. As at the time of writing, curriculum for PhD in Information Technology was developed by the department of Computer Science and had been approved by the university Senate. The programme would be mounted soon. Curriculum for MSc. Mathematics was also developed and had been passed by the Faculty's Postgraduate Board. It had since been submitted for consideration by the Curriculum Development Committee of the School of Postgraduate Studies, which if found appropriate, should after consideration make recommendation for it to be presented for Senate approval.

Before commencement of my PAP, there was no laboratory manual for the conduct of laboratory practicals. However since commencement of my PAP till the time of writing, a total of nine laboratory manuals had been developed for practical laboratory based courses in B.Sc. Biology, B.Sc. Chemistry and B.Sc. Physics programmes. Additionally, six videos had been produced complementary to the practical manuals.

Challenges Associated with the Execution of my PAP

Some parts of my PAP were adopted by the university. They were not always a success story though. Once a project becomes too large, management becomes a challenge, and that was experienced in the course of executing my PAP. The section below enumerates steps in the process of up-scaling plans, highlighting successes and failures.

Some unforeseen circumstances threatened the execution of my PAP, often times leading to extended duration of the exercise (Figure 1). The university calendar was reviewed a couple of times with the introduction of new central university activities and re-run of examinations, which were centrally coordinated, due to compromise of examination process which had to be curbed, and that affected certain work plans. These ate into the time for monthly Faculty Seminars for instance, thus the monthly seminar series was destabilized in 2018. However, it is hoped that by 2019 when the university calendar would have been better streamlined, more time would be available. In some cases, key tasks were taken over by the university and hence escalated to university projects, rather than Faculty business (Figure 2). In such a case, executing the action plan became more challenging because of the resulting larger size and the need to interact with other units of the university in planning the event. Two of the key tasks fell within this category but they ended up being highly successful. At other times, the key task just fizzled out and became comatose or compromised and mixed-up. In such situations, the Dean as a middle manager became sandwiched between opinions of top University Management and Faculty staff; hence the need to understand the politics of staying safe and sane sandwiched between the two sides of the divide.

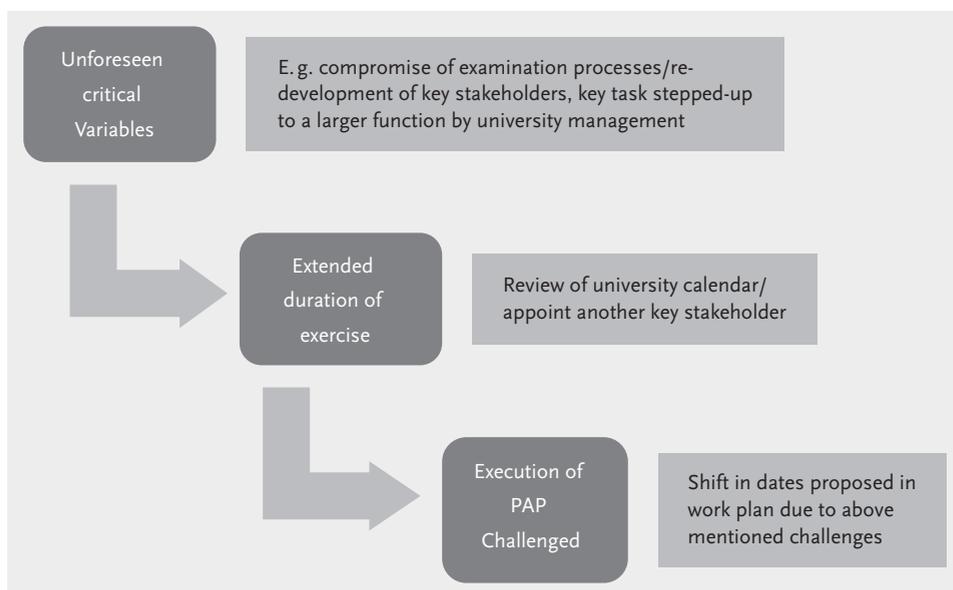


Figure 1: Some factors that challenged the execution of my project action plan (PAP)

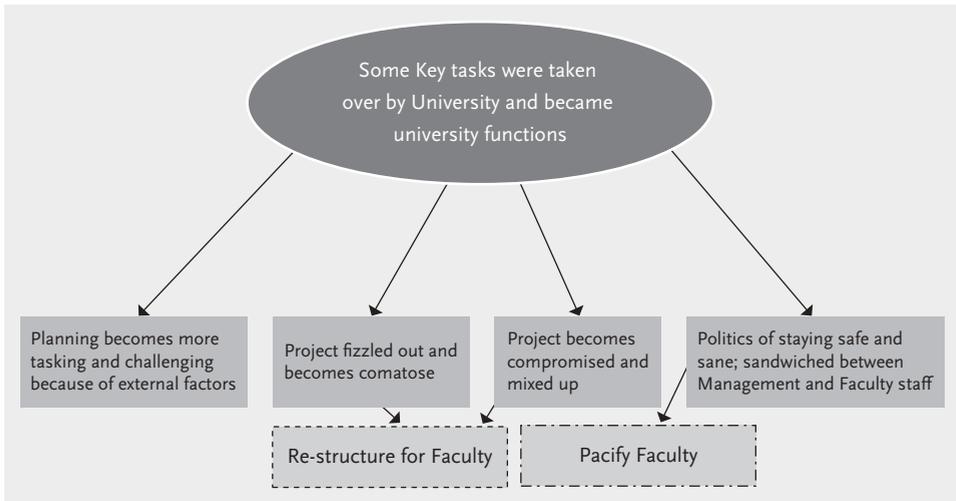


Figure 2: Difficulties encountered when key tasks were escalated outside the original plan

Discussion

Practical Science Training in ODL and Associated Challenges: Observations from my PAP

The training workshop on evaluating learning design in blended and online courses which was held in partnership with the University of South Africa and Open University, UK was a skills acquisition programme. Two in-house workshops on academic matters held were also to impact training and were quite useful in improving quality of pedagogy delivery in the Faculty. This workshop was escalated to university activity and as such only the Deans, Deputy Deans and Heads of Department of the Faculty of Sciences as with other faculties attended the training workshop. There is a need for a multiplication approach where the Faculty would then train its own members in order to help guide development of more interactive study materials for science courses. The Faculty has received budget approval to host its own in-house workshop in January 2019 to transfer the knowledge to other academic members of staff.

Partnership with sister universities becomes a challenge since the number of students in the ODL system is often larger than in the conventional universities and in some cases, the universities placed a limit on the number of students they could accommodate from NOUN. The large population size of NOUN students would place a heavy demand on the laboratory facilities of the partner institutions coupled with the need to up the skills of many laboratory personnel in these universities. Damages were often projected and estimated cost integrated into the agreement with sister universities. Having agreement with 36 universities as attempted in this project made the financial implication to be huge. Hence, we had to look inwards to provide education to our learners in line with the Act that set up the National Open

University of Nigeria; i. e. to ensure access with cost-effectiveness without compromising quality. If Memorandum of Understanding (MoU) is short lived, NOUN would require its own regional laboratory facilities to run practical science at regional level. Consequently, attempt was made to develop regional laboratories and two pilot locations were tested: Lagos and Abuja. Mobile laboratories across the six geopolitical zones of Nigeria are also being proposed. The Laboratory Practical Committee of the Faculty of Sciences therefore developed practical manuals to help streamline the practical training across the Study Centres. So far, manuals have been developed for nine courses in Biology, Chemistry and Physics Bachelor's programmes.

Additionally, videos of laboratory sessions were produced. The Faculty has recently submitted its request to the university Management for a multimedia approach that would combine hands-on, audio, video (on disks and online on our website) facilities with real-time online streaming of practical sessions that would be interactive, and virtual laboratories and simulations. The first set of videos which had already been prepared for B.Sc. Physics, B.Sc. Chemistry and B.Sc. Biology programmes are being formatted for mass production for students and also subsequent upload unto university's Learning Content Management System for online access by students.

Technology has helped to complement and enhance pedagogy in Open and Distance Learning (ODL). The deployment of technology in options like virtual laboratory, remote laboratory experiments and dry laboratory is helping to resolve some of the challenges associated with administering practical science in ODL. However, the peculiarity of the target audience, stakeholders or end-users of ODL in Nigeria where for instance, e-learning is slowly gaining ground, demands that acceptable mode of training be adopted. Furthermore, the National Universities Commission (NUC), the regulator of university education in Nigeria presently encourages blended learning mode for open and distance education in Nigeria. Consequently, a blend of hands-on and virtual options is advocated in the practical teaching of science. It is expected that the deployment of Information and Communication Technology (ICT) tools in teaching practical science would not only be effective (Oludeyi *et al.*, 2015) but would also solve some of the concerns of ODL including access to quality higher education for the large number of students enrolled under ODL (Moges, 2014). Consequently, a re-packaged proposal had been presented to University Management for digital intervention to include virtual laboratory and digital laboratory simulations as an integrated approach to enhance learning of science in our ODL system.

Effectiveness of my PAP on Research activities at the Faculty of Sciences and the University in General

To ensure that academics have appropriate infrastructure for impactful research, University Management approved the proposal for the completion and equipping of the laboratories in the Faculty in Abuja. The contractor had commenced work and promised to be done by November, 2018. A fully equipped software laboratory was also put in place at the Faculty for the Computer Science, Physics and Mathematics

programmes largely but also to strengthen the skills of academics in research data processing and summarization, big data management and software development. It is hoped that when other laboratories are ready, they would double for demonstration and practical classes that would be transmitted across the Study Centres using digital tools.

Often times, access to information in ODL to help build capacity in research is scarce and there is often the need to record processes. Hence floating an academic peer review journal is a means of exposing academics to the process and appreciating the academic culture of publishing research findings in peer review journals. Even though my PAP intended to create a Faculty journal, the plan came at a time when the university was moving to meet conditions to subscribe to funding by Nigeria's Tertiary Education Trust Fund (TETFUND). As a result, all science-based faculties were advised to collaborate to float a multidisciplinary journal. The faculties of Agricultural Sciences, Health Sciences and Sciences of NOUN worked together to come up with the NOUN Journal of Physical and Life Sciences (NOUN-JPLS) and agreed that the Dean, Faculty of Sciences should serve as pioneer Editor-in-Chief (E-I-C). Each Faculty nominated two subject Editors comprising the Dean and a senior faculty member.

The Editorial Board of the journal comprised internal (Subject Editors) and external (Editorial Advisers) members. The E-I-C was saddled with the responsibility of inviting credible scientists across regional and global divide and the contact I made with colleagues at IDC 2017/2018 became very useful and relevant. Leveraging on the interactions with colleagues at IDC 2017/2018 contact sessions and submissions of other Deans of partnering faculties, the Editorial Board of NOUN-JPLS was established with an international outlook and desired quality. The journal intended to produce two issues annually in June and December. At the time of writing this report, Volume 1, Issue 1, 2017 of the journal has been produced while Volume 2, Issue 1 is being concluded for 2018. Manuscripts for Volume 2, Issue 2, 2018 and Volume 3, Issue 1, 2019 are receiving Reviewers' attention. NOUN Journal of Physical and Life Sciences (NJPLS) is the first harmonized journal series of the university and is formally registered with the national Library with ISSN. It can be accessed at its launched website www.njpls.nou.edu.ng.

With increased awareness about research and outlet for publishing, more academics in the Faculty are imbibing the academic culture of publishing and international best practice in research and academic activities. There was 44% increased performance as reflected in the number of academic staff members promoted in January 2018 compared to January 2017. Consideration of academics for promotion is largely by their research output based on amount and quality of their publications.

Following the series of meetings engaged with the academic staff members in development category cadres, they are now increasingly making moves to acquire PhD degrees. This implied that this category of academic staff is becoming more aware of the need for career development and research. This would further strengthen research outputs of academics in the Faculty and as well develop capacity.

Increasing the capacity of academics in the Faculty of Sciences to engage in development-oriented research spurred the urge to increase academic staff strength. Unfortunately university Management policy occasioned by reduced government's budgetary allocation for overhead implied that enough permanent academic personnel could not be engaged. The Faculty, therefore, looked into engaging Facilitators, who are part-time employees, in more Faculty tasks. This further ensured availability of quality time for research. A research workshop was held and the fall-out was constitution of two research teams for the Faculty who harmonized areas of competence and defined two areas of focus to develop multi- and inter-disciplinary research proposals.

The effectiveness of the research workshop and the resultant break-out teams was demonstrated when about 46 % of academic staff members from the Faculty of Sciences were involved in the preparation of two proposals that the National Open University of Nigeria submitted for the Africa Centre of Excellence project Phase 3 to be funded by the World Bank. This was a first time experience for NOUN. The concept of the two proposals developed and submitted by university originated from the Faculty of Sciences. Related faculties also participated in the development of the multi-disciplinary proposals. Considering that there are 8 Faculties in the university, the role of the Faculty of Sciences at setting the pace and our efforts are beginning to project the university's relevance in national and regional development is already clearly defined.

Even though academics were not able to patent any product yet, those who were part of the ACE proposal writing were able to receive university financial reward for the preparation of ACE research proposal. The university also funded their stay in hotel for the period in which the proposals were written in conference. Although patent had not emerged, it is largely because time is required to get research done with resultant products that could be patented. Since research fire has been ignited now in the faculty, it is only a matter of time. Additionally, the Research Administration and Advancement Directorate of the university is developing research policy, ethics and IPR for the university.

Reward system initiated yielded good result. It was observed that some academic staff members became more relaxed, friendly and less touchy after realizing that other members of staff of the Faculty could actually determine the recognition given them. This resulted in improved interpersonal relationships and more friendly work environment. The welfare package has also contributed to reducing tension in the Faculty as there was regularly time to cool off the heat and socialize.

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