COMPARATIVE ASSESSMENT OF UNIVERSITY CHEMISTRY UNDERGRADUATE CURRICULA IN SOUTH-WESTERN NIGERIA

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ABSTRACT

A comparative analysis of the structure of undergraduate chemistry curricula of universities in the southwest of Nigeria with a view to establishing the relative proportion of the different areas of chemistry each curriculum accommodates. It is a qualitative research, involving content analysis with a partial quantitative analysis in terms of numbers of courses of different status in each curriculum. Five federal, three states and two private universities offering Pure Chemistry, were purposely selected. Frequency counts and percentages were used to present the quantitative results. The areas of chemistry covered are Introductory, Inorganic, Physical, Organic, and Quantum and Analytical chemistry. Some direct applications of chemistry include courses in Environmental, Industrial, Polymer, Rubber and Brewing Technology. However, there are discrepancies with respect to comprehensiveness of courses' contents in the different areas of chemistry. The federal and private universities adhere more strictly with the National University Commission (NUC) respective course content requirement. All the universities, except one, do not have 100% compliance with respect to total number of compulsory, elective and practical courses. The universities are enjoined to have 100% compliance with NUC guidelines and may include varieties of elective courses to meet the different career aspirations of the chemistry undergraduates. *[African Journal of Chemical Education—AJCE 7(1), January 2017]*

INTRODUCTION

Science and technology have always been part of the quest for development since industrial revolution. In the 21st century, both Science and Technology together constitute the pivot of manufacturing industries, medicine (both human and veterinary), agriculture, communication, housing, urban and regional planning, public utilities like water and electricity, just to mention a few. At the secondary education level the basic science subjects are Chemistry, Physics and Biology. At the tertiary education level particularly in the universities where science-based courses are studied, Chemistry is the only school subject that is embedded in all the science-oriented disciplines. Furthermore, Chemistry is also a discipline on its own at the university level with various specialisations like Pure and Applied Chemistry, Analytical Chemistry, Industrial Chemistry, Biochemistry, Petroleum Chemistry, Geochemistry and others.

Hybrid names such as "agricultural chemistry, archaeological chemistry, consumer chemistry, cosmic chemistry, geochemistry, human chemistry, nutritional chemistry, environmental chemistry, fuel chemistry, forensic chemistry, food chemistry and oceanic chemistry," attest to both the diversity and usefulness of chemistry and its close ties to other fields of science and technology. [1] The diversity of fields related to chemistry shows that chemistry by its very nature is the central science [2]. It is central to the fundamental understanding of all other fields of Science and Technology [3].

Chemistry Is "the science of matter that deals with the composition and properties of substances and the changes they undergo". [4]. It is the science of matter and its transformations [5]. Matter, from the chemical point of view, consists of the substances we encounter in our daily lives, such as solids, liquids, and gases, as well as the atoms and molecules of which these

substances are composed. Chemistry is thus defined as the science of matter and changes which it undergoes.

Chemistry provides answers to many fundamental questions about the material world. It is not out of place then to support the school of thought that for a choice of career as a chemist, biochemist, research scientist, doctor, pharmacist, toxicologist, teacher, lawyer, entrepreneur or even engineering disciplines, a degree in chemistry can be the starting point. The curriculum, through which undergraduates are awarded the Bachelor of Science degree, is expected to lay a good foundation for the areas of study relating to chemistry. It is also expected that the curriculum will equip such student to contribute meaningfully to national and global development as a scientist.

Education is regarded, globally, as a potent instrument for introducing and sustaining social change in human societies, shaping its destiny as well as serving as a vehicle for enhancing upward social and economic mobility [6] Education imparts knowledge, teaches skills, and instils attitudes to its recipients. Imparting knowledge means putting across facts, current thinking, theories, principles or laws; teaching skills is imparting practical skills, comprehension and ability to see implications or solve problems; instilling attitudes include inculcating tolerance, open-mindedness, scientific detachment and healthy scepticism. [6] [7].

The purpose of education in Nigeria also includes unparalleled development of science and its application to industry and technology for better living. The National Policy on Education spells out the purpose of Education in Nigeria as an:

> *"instrument par excellence for effecting national development; a tool to achieve its national objectives; satisfying the needs of the individual and setting its goal in terms of the kind of society desired in relation to the environment and realities of the modern world and rapid social changes" (p. iv)."[8].*

One of the main objectives of university education in Nigeria is the production of skilled manpower to drive the economy as well as contribute meaningfully to the scientific and technological development of the nation. For Chemistry at undergraduate level in particular, the primary objective is the production of graduates who are presumed to be adequately prepared for effective performance as Chemists in future employments. Such graduates are expected to be resourceful, adaptive and innovative in any area they may find themselves. Graduates who hold degrees in Chemistry occupy a variety of positions in industries, government and the academia. Those who work in the chemical industry serve as laboratory chemists where they carry out experiments to develop new products (research and development), or analyse materials (quality control) or carry out diagnosis.

Relying on the National Universities Commission (NUC) Decree (Act) No. 16 of 1985 as amended Decree No. 48 of 1988 which empowers the Commission to set minimum standards for all programmes in Nigerian universities, the Commission in collaboration with the universities developed the Minimum Academic Standards (MAS) for all the existing programmes in 1989 and this was subsequently approved by the Federal Government of Nigeria later in the same year. The MAS was later reviewed in 2001. The review produced a new document which is an outcome-based benchmark statement for all the university programmes in line with contemporary global practice. The benchmark-style statements were considered inadequate for curricula development and accreditation purpose and were therefore merged with the revised MAS to produce a new document known as Benchmark Minimum Academic Standards (BMAS) for all disciplines.

A degree program in chemistry is expected to foster in undergraduates an appreciation of the centrality of chemical science to human well-being as well as its inevitable linkage to and interactions with other branches of science. Summarily, graduates of Chemistry are expected to

have the ability to apply knowledge and skills to solving theoretical and practical problems in Chemistry and other allied industries in relation to national and societal needs. [9].

The narrow and broad conceptions of curriculum [10] are as follows:

Narrow conceptions of curriculum

1. The subject matter that teachers and students cover in their courses
2. The contents of instructional program
3. The set of courses, exercises or field work, etc. that make up a certain part of a program
4. An integrated course of academic studies
5. A program of courses comprising the formal requirements for a particular area of study.

Broad conceptions of curriculum

1. A comprehensive over-view, including activities planned for delivery to the students, the scope of content, and the sequence of materials and balance of subject-matter and motivational instructional and assessment techniques to be used to achieve a set of ordered, intended outcomes.
2. A structured plan of intended learning outcomes, under-pinning knowledge, skills, behaviour and associated learning experience. (p.524-5)

The effective teaching and learning of any subject at any level is anchored on the curriculum put in place for the subject. Curriculum is to be regarded "as a school-generated experience that ensures a permanent positive transformation in us and turns us into life-long learners facing the challenges of existence headlong as they arise in a dynamic world environment context". [10] The Education strategist is of the opinion that a well-developed curriculum should engender a spirit of life-long learning, which enables those who experienced the curriculum to cope effectively with life-long challenges as they arise. Put very simply, a curriculum can be

referred to as guide or manual that tells the teacher about the nature and characteristics of the learners to teach, the content to teach, the methods and strategies to use in teaching and assessing learners. In the same vein, it was ascertained that "without an effective curriculum, students would not be able to understand or meet the challenges of the society". [11].

Curriculum delineates the skills and concepts taught and evaluated to enhance students' achievement. It is composed of a content area, philosophy strands with definitions of goals, scope, sequence, learning outcomes and assessment tools. It is intentionally designed to meet district, state and national standard. A well-developed curriculum will specify the knowledge, skills, insights and attitudes that learners will be expected to acquire (i.e. learning objectives or outcomes), the in-class and out-of-class learning activities that will aid learners to learn (i.e. learning experiences) as well as teacher's activities[10].

This study involves the comparative analysis of the Chemistry curricula of some Nigerian Universities. The importance of curriculum evaluation has to do with the determination of the value of the curriculum itself as well as the appropriateness for the particular group of students for which it is being used. It is also to show the relevance of the instructional methods relative to the objective of the educational programmes, and the appropriateness of materials recommended for instructional purpose. The objectives of curriculum evaluation on the other hand include the determination of the outcomes of a programme, help in the decision on whether to accept or reject a programme, ascertaining the need for revision of curriculum content, help in future development of the curriculum materials for content improvement, and improvement of methods of teaching and instructional techniques [10].

In Nigeria, as earlier stated the minimum standard of the curricula for courses at the university level was designed by the central governing body for universities i.e. the National

Universities Commission (NUC). Nigeria as at May 2015 has a total of one hundred and thirty-eight (138) registered Universities. This number is made up of forty (40) federal, thirty-nine (39) state and fifty-nine (59) privately owned. The Universities are scattered across the country with a sizeable chunk located in the Southwest. Since the minimum standard of curricula for courses are specified by the NUC which is the statutory supervisory body for universities, the following questions among others naturally arise with particular focus on Chemistry:

i. To what extent do the Chemistry curricula use in Nigerian Universities compliant with the minimum guidelines specified by the National Universities Commission?
ii. How do the Chemistry curricula in use in federal, state and private Universities in Nigeria compare with the NUC specified guidelines?
iii. How is the chemistry curriculum exposing the undergraduates to the different aspects of chemistry that can consequently prepare the undergraduates foundation for other science related disciplines?
iv. How is the curriculum equipping the students with basic skills for scientific/ technological development so as to achieve part of the aim of tertiary education in Nigeria?

These questions arise as a consequence of the importance of chemistry as a core subject for Science and Technology. If the country is to develop technological capacity, there is need to ensure high quality and uniformity of the curriculum in schools with particular reference to Chemistry at the university level which is the focus of this study.

THE PROBLEM

The effective teaching and learning of any subject at any level depends heavily on the curriculum put in place for the subject. A search through literature on curriculum studies revealed

an in-depth research into aspects such as curriculum development, challenges or constraints of curriculum implementation, curriculum innovation, assessment or evaluation of curriculum, and comparative analysis of the curriculum in some subject areas especially at the secondary school level. However, there is a need for a study in the area of comparative analysis regarding Chemistry curriculum most especially at the undergraduate level in the Universities in Nigeria.

This study is therefore focused on a comparative analysis of the Chemistry curriculum of Nigerian Universities with emphasis on those located in the Southwest of the country. This is to find out if such curriculum is in compliance with the minimum guidelines specified by the National Universities Commission (NUC) which is the supervisory body for Universities in Nigeria and to what extent. The study also compares and contrasts the Chemistry curricula of the different units of the sampled Universities, which are aimed at achieving the same goal of the award of the Bachelor of Science degree in Chemistry with the NUC guidelines using the variables such as structure, total number of credits units allotted to different aspects of chemistry among others as guide.

RESEARCH QUESTIONS

Considering the problems discussed above, the following questions become relevant:

i. To what extent do the structure of Chemistry curricula used in Nigerian Universities is in compliance with the minimum guidelines specified by the National Universities Commission?

ii. How do the Chemistry curricula of the federal, state and private Universities in Nigeria compare with the NUC specified guidelines with respect to the pattern and proportion of the different areas of chemistry in the curriculum of South-Western Nigerian Universities?

iii. Does the structure and content of the respective university undergraduate curriculum expose students to all major areas of chemistry?

iv. Does the structure and content of the undergraduate chemistry curriculum designed for development of vocational skills in the students?

METHODOLOGY

This is descriptive study. The curricula of the sampled universities were content analyzed for the sake of comparison to determine their points of congruence and divergence. Descriptive statistics were also used to present some data thereby making the design a mixed method approach – quantitative and qualitative.

The population of the study comprises all the approved universities in the South-west of Nigeria across the different ownerships of federal, state and private. Purposive sampling technique was used to select five universities from federal, three from state and two privately-owned making a total of ten. The federal universities are designated FU 1, FU 2, FU 3, FU 4 and FU 5. The state-owned universities are designated SU1, SU 2, and SU 3; while the privately owned universities are designated private PU 1 and PU 2.These are universities offering Pure Chemistry. Their Chemistry curricula were compared with the minimum guidelines specified by the National Universities Commission. [12].

The variables of interest in this study are

i. number of chemistry courses and the total number of credit units attached to them

ii. number of listed compulsory Chemistry courses and the total number of credit units attached to them

iii. number of available elective Chemistry courses and the total number of credit units attached to them

iv. number of Chemistry practical courses and the total number of credit units attached to them

v. proportion of courses in the different aspects of chemistry in respective university curriculum and

vi. proportion of courses that can possibly equip the undergraduates with vocational skills among the courses in the respective university curriculum

The curricula from the different sampled Universities served as the instruments for the study. The data from this study were collected by the researchers through content analysis. Descriptive statistics involving frequency counts and percentages were used for the analysis of the data collected. These were supported by pictorial representations for the purpose of clarity.

RESULTS AND DISCUSSION

Table 1: Total number of Chemistry courses offered and the respective credits unit allotted

University/NUC	Total No. of Chemistry Courses	% compliance with NUC in terms No. of Chemistry Courses	Total No of credit Units	% Compliance with NUC in terms Total No of credit Units
NUC	51	100.0	129	100.0
FU 1	34	66.7	104	80.6
FU 2	51	100.0	133	103.1
FU 3	49	96.1	123	95.3
FU 4	54	105.9	116	89.9
FU 5	48	94.1	103	79.8
SU 1	43	84.3	98	76.0
SU 2	31	60.8	70	54.3
SU 3	35	60.6	91	70.5
PU 1	46	90.2	108	83.7
PU 2	47	92.2	105	81.4

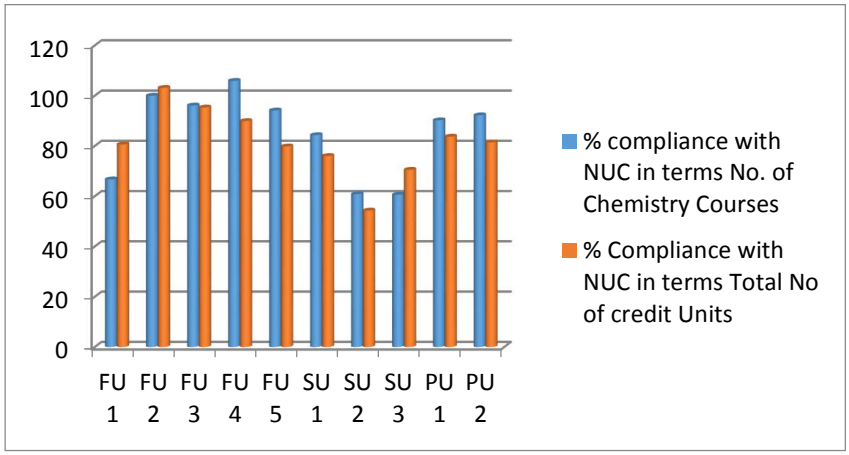

Figure 1: Total number of Chemistry courses offered and the respective credits unit allotted FU-Federal University; SU-State University; PU-Private University

Table 2: Analysis of universities course outlines

UNIVERSITIES	Total No. of courses		Compulsory courses		Elective courses		Practical courses	
	Of Chemistry	Credit Units	No/% of Unit	No/% of Credit Units	No/% of Unit	No/% of Credit Units	No/% of Unit	No/% of Credit Units
NUC	51	129	22 ***43.1***	62 ***48.1***	24 ***42.1***	57 ***44.2***	05 ***9.8***	10 ***7.8***
FU 1	34	104	28 ***82.4***	83 ***79.8***	05 ***14.7***	19 ***18.3***	01 ***2.9***	02 ***1.9***
FU 2	51	133	21 ***41.2***	66 ***49.6***	25 ***49.0***	57 ***42.9***	05 ***9.8***	10 ***7.5***
FU 3	49	123	24 ***49.0***	74 ***60.2***	17 ***34.7***	37 ***30.1***	08 ***16.3***	12 ***9.8***
FU 4	54	116	34 ***53.0***	85 ***73.3***	12 ***22.2***	23 ***19.8***	8 ***14.8***	8 ***6.9***
FU 5	48	103	40 ***83.3***	87 ***84.5***	7 ***14.6***	14 ***13.6***	1 ***2.1***	2 ***1.9***
SU 1	43	98	34 ***79.1***	78 ***79.6***	8 ***18.6***	19 ***19.4***	1 ***2.3***	1 ***1.0***

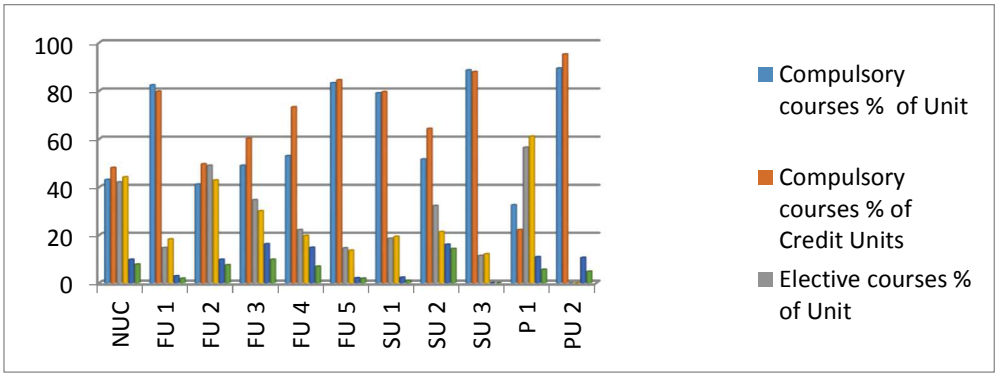

Figure 2: Analysis of universities course outlines

Figure 1 indicates that in terms of the total numbers of Chemistry courses in each of the sampled universities, only FU 2 has a percentage compliance of 100%. All the other sampled Universities have a compliance level range of 60.8% -105.9%. Also with respect to number and credits units of compulsory courses all the universities except two have more courses and allotted credits more than those of the NUC guideline. (See figure 2). Whereas FU 1 has fifty –one (51) number of courses which tallies with the NUC recommendation, others have smaller units with SU2 and SU3 being as low as 31 and 35 respectively. The lower number of courses in SU 2 is attributable to the merger of some of the recommended courses. These observations show that there are differences in what is offered the students in those Universities compared to what is recommended by the NUC. This is contrary to the spirit of the NUC 2007 BMAS document which was evolved by a process which took cognisance of the inputs from all the existing universities as at then to ensure uniformity of the programmes in the various universities.

However, in the cases with higher number of courses particularly with respect to compulsory courses than the NUC recommendation, the universities really aim at giving the graduates sound basic background in chemical knowledge without option of courses in chemistry.

It is expected that the students can still offer courses from other departments, to meet graduation requirement.

Table 3: Analysis of the proportion of the respective number and credits units allocated to the different areas of Chemistry

			General (Intr.)	Physical	Inorganic	Organic	Analytical	Environmental	Quantum/ Nuclear	Vocational	Others	Total
1	NUC	No. of Units	2 ***3.9***	7 ***13.7***	9 ***17.6***	*10* ***19.6***	2 **3.9**	1 ***2.0***	2 ***3.9***	6 ***11.8***	12 ***23.5***	51
		Total credits units	7 ***5.4***	16 12.4	22. ***17.1***	25 ***19.4***	5 **3.9**	3 ***2.3***	5 ***3.9***	17. ***13.2***	29 ***22.5***	129
2	FU 1	No. of Units	-	6 ***17.6***	***5 14.7***	***8 23.3***	4 **11.8**	-	3 **8.8**	5 **14.7**	3 **8.8**	34
		Total credits units	-	21 **20.2**	17 **16.3**	24 **23.1**	13 **12.5**	-	8 **7.7**	13 **12.5**	7 **6.7**	104
3	FU 2	No. of Units	2 ***3.9***	9 ***17.6***	5 ***9.8***	12 ***23.5***	2 ***3.9***	1 ***2.0***	4 ***7.8***	6 ***17.8***	10 ***19.6***	51
		Total credits units	7 ***5.3***	21 ***15.8***	15 ***11.3***	30 ***22.6***	5 ***3.8***	3 ***2.3***	10 ***7.5***	17 ***12.8***	25 ***18.8***	133
4	FU 3	No. of Units	3 ***6.1***	8 ***16.3***	8 ***16.3***	10 ***20.4***	3 ***6.1***	1 ***2.0***	7 ***14.3***	3 ***6.1***	6 ***6.2***	49
		Total credits units	11 ***8.9***	20 ***16.3***	20 ***16.3***	25 ***20.3***	6 ***4.9***	2 ***1.6***	22 ***17.9***	5 ***4.1***	12 ***9.8***	123
5	FU 4	No. of Units	3 ***5.6***	17 ***13.0***	6 ***11.1***	11 ***20.4***	8 ***14.8***	1 ***1.9***	2 ***3.7***	4 ***7.4***	12 ***22.2***	54
		Total credits units	7 ***6.0***	17 ***14.7***	13 ***11.2***	26 ***22.4***	17 ***14.7***	2 ***1.7***	4 ***3.4***	11 ***9.5***	19 ***9.5***	116
6	FU 5	No. of Units	2 ***4.2***	6 ***12.5***	3 ***6.3***	8 ***16.7***	3 ***6.3***	2 ***4.2***	2 ***4.2***	15 ***31.3***	7 ***14.6***	48
		Total credits units	8 ***7.88***	13 ***12.6***	5 ***4.9***	15 ***14.6***	6 ***5.8***	4 ***3.9***	4 ***3.9***	32 ***31.1***	16 ***15.5***	103
7	SU 1	No. of Units	2 ***4.7***	9 ***20.9***	6 ***13.9***	13 ***30.2***	3 ***7.0***	1 ***2.3***	1 ***2.4***	3 ***7.0***	5 ***11.6***	43
		Total credits units	8 ***8.2***	20 ***20.4***	13 ***13.3***	28 ***28.6***	7 ***7.1***	2 ***2.0***	2 ***2.0***	7 ***7.1***	11 ***11.2***	98
8	SU 2	No. of Units	2 ***6.5***	5 ***16.1***	4 ***12.9***	8 ***25.8***	1 ***3.2***	1 ***3.2***	1 ***3.2***	4 ***12.9***	5 ***16.1***	31
		Total credits units	7 ***10.0***	10 ***14.3***	8 ***11.4***	17 ***24.3***	2 ***2.9***	2 ***2.9***	2 ***2.9***	10 ***14.3***	12 ***17.1***	70
9	SU 3	No. of Units	2 ***5.7***	6 ***17.1***	5 ***14.3***	12 ***34.3***	2 ***5.7***	1 ***2.9***	3 ***8.6***	2 ***5.7***	2 ***5.7***	35
		Total credits units	8 ***9.8***	17 ***18.7***	10 ***11.0***	27 ***29.7***	6 ***6.6***	2 ***2.2***	6 ***6.6***	6 ***6.6***	9 ***9.9***	91
10	PU 1	No. of Units	-	9 ***19.6***	4 ***8.7***	10 ***21.1***	7 ***15.2***	4 ***8.7***	2 ***4.3***	6 ***13.0***	4 ***8.7***	46
		Total credits units	-	19 ***17.6***	7 ***6.5***	20 ***18.5***	16 ***14.8***	8 ***7.4***	4 ***3.7***	19 ***17.6***	15 ***13.9***	108
11	PU2	No. of Units	-	9 ***19.1***	9 ***19.1***	11 ***23.4***	3 ***6.4***	2 ***4.3***	3 ***6.4***	8 ***17.0***	2 ***4.3***	47
		Total credits units	-	21 ***20***	15 ***14.3***	26 ***24.8***	6 ***5.7***	5 ***4.8***	7 ***6.7***	15 ***14.3***	10 ***9.5***	105

(Percentages are written in bold)

Table 3 shows the relative number of units and respective credits units allocated to the different areas of chemistry by each of the university sampled for the study. There were courses in the areas of physical, inorganic, organic, analytical, and nuclear/quantum and Environmental, others are quantum/Nuclear, vocational, Industrial and students project requirement for graduation.

There are clear inconsistencies in the proportion of courses for different aspects of chemistry when compare with the NUC specifications. Examples are FU 1, SU 1, SU 2 and SU 3 where the total number of chemistry courses is 34, 42, 30 and 34 respectively compared with 51 of the NUC. However in the case of FU 1, there are courses with heavy credit units which were like combination of two or more equivalent courses in the NUC curriculum. The total credit unit of FU 1 is 104 while those of the other Universities with inadequate courses are 96, 68, 89 and 89 respectively.

A federal University (FU1) and the two private universities have no course designated as introductory, or general chemistry course as stipulated by NUC. The equivalent introductory courses are introduced to the student under their identified demarcation as physical, inorganic, organic or otherwise especially in FU 1. One Federal University (FU3) even had so much elaboration and very comprehensive introductory university chemistry, while the Universities of Technology FU4 and FU5 had scanty content of such equivalent courses. Universities can present Introductory chemistry courses in different ways especially when they have to give consideration to all other categories of undergraduates who need to have a foundation of their discipline in chemistry. In University of Michigan for example, for chemical science major students, premedical students and even engineering students, a comprehensive introductory chemistry course was packaged as Structure and Reactivity. The course is a perfect introductory organic chemistry [13].

Even as far back as 1927 till later in the 1940s[14] [15].; organic chemistry has served as first undergraduate chemistry course in many universities in the United Kingdom and United States of America. However, students still need holistic knowledge of chemistry.

A federal University FU1 and State University SU3 have no specific Electrochemistry course. The course content on statistical mechanism of SU1 I not given in detail. Also FU4 and FU5 have no specific course on Advanced Statistics. Three universities, SU2, PU1 and PU2 have no course on Main group elements; however, only PU1 has a course devoted to Water analysis.

The National University Commission has 19.4% of her courses on Organic Chemistry, while for other Universities except for FU 5 and PU 1; the universities have over 20% of the credits units of courses devoted to Organic Chemistry. The areas of Organic Chemistry and by extension applied Chemistry covered by the university varies from one university to another, only FU2 comply much with the NUC speculation. Also only FU2 has a course on Olefin Chemistry. Areas of Polymer Chemistry, Petro-chemical processes, Organic spectroscopy, food chemistry were all treated with varying degree of comprehensiveness across the universities. Many careers such as in the health sector, food processing industries extractive industries, chemistry and petro-chemical industries among others need to build their foundation in chemistry [16].

Many of these disciplines require background knowledge of Organic Chemistry especially to cope well in their practices in the enumerated careers. This thus demands, that chemistry undergraduate's curriculum should be elaborate and cut across many areas. A lasting impact of education, more especially university education should go beyond mastering the subject matter, , it should touch on the strength of life-coping and learning -to learn skill which would become an integral part of the learner and cause a transformation of behavior [10].

Only one course with a credit unit of three is obvious as an Environmental Chemistry course in the NUC guideline. FU 2, FU 3, FU 4, and FU 5, similarly SU1,and SU2 the Federal and states universities respectively have at least a course with different credit units on Environmental Chemistry. The private universities both have at least two courses on Environmental chemistry.

The courses under 'Others' are courses declared as seminar, industrial, natural products, food, and main group chemistry and/or projects. FU 4 has as many as 12 courses of this type, 22% of the total number of courses though with relatively low credit units. Next to this is FU1 with 10 courses but relatively heavier credit unit for the courses. Research project of six units is inclusive.

Research question 4: Does the structure and content of the undergraduate chemistry curriculum provide for development of vocational skill in the students? Table 3 shows that there are courses that could be regarded as vocational courses in all the universities. The NUC curriculum suggested 6 courses (11.8%) of chemistry courses being offered with sub-total credits of 17 (13.29% of the total chemistry courses. Only FU 5 has so many vocational courses that are even more than double the NUC specifications, probably because it is a university of technology while SU 3 has the minimum vocational chemistry course in this respect. Courses that could be regarded as vocational courses are treated sparingly in many of the universities.

he topics that are taught in many chemistry courses at undergraduate level are becoming too sacrosanct and not so important; rather there is need for more practical, feasible, and entrepreneurial development courses. This is one of the reasons why students who are enrolling in for postgraduate studies in chemistry are preferring Applied chemistry, Analytical chemistry, Industrial chemistry or Environmental chemistry to Physical, Inorganic or Organic chemistry. Amongst a total of 139 chemistry undergraduates who intend to go for postgraduate studies in

chemistry, only 27% of them were interested in Analytical chemistry, followed by Industrial chemistry and Organic chemistry in that order; 17.3% and 12.9% respectively [17].

These students feel that chances of employment and/ or retention of job in manufacturing or production related organizations are high with specialization in analytical chemistry. Only a few students 4.3% that have confidence in their mathematical abilities could afford to go further in physical chemistry [17].

During a recent unofficial interaction with some chemistry undergraduates, Environmental chemistry seems to be the most preferred because what is more required now is sustainable development which can be found in maximum utilization of our Environment, since chemists are responsible for answering fundamental questions about the material world.

Chemistry as a science discipline can be described as the index of industrial development [2]. On the contrary, however, many undergraduates including those of chemistry department don't really have a clear understanding of the prospect of the course they are studying. In a study involving 234 final year chemistry undergraduate, 68% of them could not decide what career they can pursue on graduation [16]. Considering the series of university curriculum review co-ordinated by the NUC arising from the June 2004 conference, Nigerian graduates are not expected to be unemployed. [18].

The National Association of Pre-Chancellors of Nigerian Universities declared in a committee of their third Biennial Seminar that many Nigerian Graduates are not employed because they are unemployable.[19] It was reported [18], that 60.8% of a cross-section of administrative personnel believes that Nigeria undergraduates are employable. Amongst reason for non-employability given by 39.14% of the administrators is inadequate exposure to job training schemes. [20]. There is a suggestion that for science graduates to be employable, generic skills

should be incorporated into their respective undergraduate curricula. [21] And these must be generic skills that can support study in any discipline [22].

CONCLUSIONS

The curriculum of chemistry undergraduates in many Nigerian universities especially those in the South Western part of the country, irrespective of the ownership, to a large extent expose students to all aspects of chemistry. However, considering the centrality of chemistry to other fields of study, to other sciences, health engineering and for sustainable technological development, students need more application-oriented chemistry courses. There should be a good number of elective chemistry courses that can cater for different areas of interest and students' aspirations, with some flexibility in terms of requirements for graduation.

The counselling units of Students affairs need to continually organise vocational guidance for students to make maximum benefits of the course they are pursuing with or without government employment. There is need for uniform orientation of chemistry for all categories of students as stipulated by a quality control body such as NUC and for these courses to be presented in less abstract but in the way it can easily be applied to the different disciplines .Professional associations of Chemistry such as the Chemical Society of Nigeria should take interest in what Universities teach and assist NUC in monitoring the quality of curriculum and graduates produced.

Again, going by the current global economic situation more especially in Nigeria where graduate unemployment is growing at an alarming rate, a graduate of Chemistry should be able to benefit from the vocational features of chemistry. At the undergraduates level more vocational embedded courses should be included in the curriculum not only in university of technology but in all the convectional universities as well. Industries that employ graduates of Chemistry should

also give feedback to Universities and Department about the training of their graduates. This will improve service delivery of Chemistry departments and employability of their graduates. Chemistry graduates can also be equipped enough to be self-reliant upon graduation.

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