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Comparative Analysis of International and Nigeria Universities Curriculum for Petroleum Engineering: Delta State University as a Case Study

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Abstract
The purpose of this research work is to (i) determine the extent the present DELSU curriculum for the petroleum engineering department is consistent with those of other Nigerian universities (ii) to identify relevant courses that will meet both national and internal challenges of the petroleum industries. The outcome of this study has made it possible for Petroleum and Gas Engineering, the Faculty, Delta State University (DELSU), and stakeholders in curriculum development to know the status of the current petroleum and gas engineering curriculum. The research has made us know the differences in the local curriculum and those of the international countries, in terms of course replication, too much emphasis on elementary and general courses to the detriment of the core petroleum courses at the early stage of the program. This knowledge will greatly assist the department to take appropriate actions to develop a better curriculum.

Introduction
Curriculum denotes the means and materials with which students will intermingle to achieve recognized educational outcomes. From the learner perspective, the curriculum is only that portion of the plan that right affects the students. That is, the experiences the students got and able to use for the development of the self, the community, and service for human growth and development (Adesoji and Alade 2010). Therefore, any aspect of the planned curriculum that is not made to bear on the experiences of the students is regarded as an educational desire, but not a curriculum. Bruner (1960) was quoted to have written thus: "Many curricula are initially prearranged using a guiding idea. But as curricula are truly executed, as they grow and change, they often lose their unique form and suffer a relapse into certain shapelessness". To this end, therefore, a curriculum no matters rich it maybe can only be that portion of the plan that is taught the student. The curriculum that is planned that recognizes its full implementation can be expected to result in a more focused curriculum.

Curriculum development is the prearranged preparation of whatsoever is accepted to be taught in schools at an agreed time in a particular year. They are made into certified documents, as guides for teachers, and made compulsory by government and departments. It is essentially up to the

teachers themselves in what way these rubrics should be made, just how these worksheets should be made and taught; it's all up to the teachers. In a real understanding, there is no actual way to say what procedure is right to use. But it is also correct that how a topic is taught normally resolves what is taught. This is why it is essential to make a difference between the official or planned curriculum (Okebukola 2010).In planning the curriculum, the planner ideology is centered on the following four areas (1) To find what educational values must be reached by schools (2) The best way of determining what types of learning experiences are appropriate to be valuable in reaching these objectives(3)The finest way of placing in order familiarity with learning for real instruction and (4)The best way of evaluating the above-mentioned acquaintance of learning.

The development of an active curriculum guide is a multi-step, continuing, and cyclical process (Obanya 2005). In a broad sense, the curriculum development process includes the design, development, implementation, and evaluation of curricula (see figure 1. However, as one studies the process more thoroughly it becomes obvious that each element may itself include numerous varied but inter-related activities. The Curriculum Development is charged by the responsibility to operationalize the Curriculum Development Process. Therefore, the work of the curriculum developer may be more effectively termed as designing, developing, implementing, monitoring, evaluating and reviewing curricula(as shown in figure 1) that are suitable and significant to the needs and benefits of a developing nation, such as Nigeria.

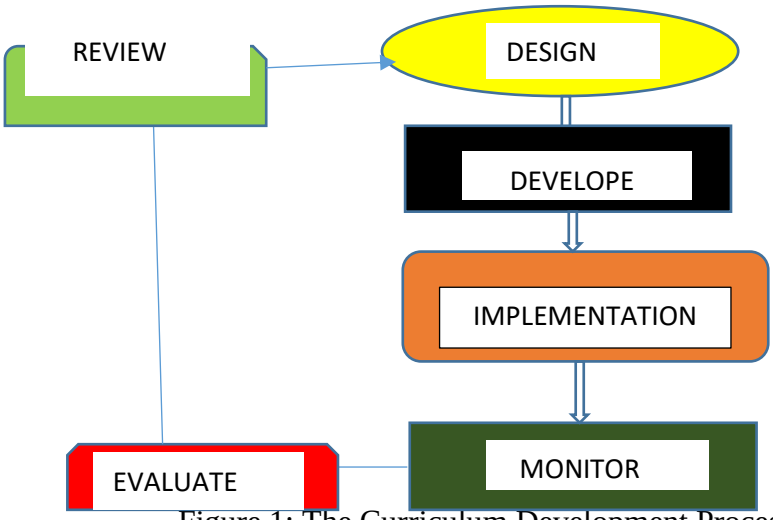

Figure 1: The Curriculum Development Process

Reflecting on the excerpts of the publication in the daily independence titled: Petroleum engineering curriculum in Nigerian varsities obsolete – Minister, SPE by (Esiedesa Obas 2014**).** Within the framework of this observation lies the fact that a lot of research has been done in petroleum drilling technology, production, refining processes, and human factors in the petroleum industry. (Maihankuri 2012) in his study concluded that the educational curriculum has become inadequate for the training of personnel for the industry. The current petroleum engineering curriculum was adapted from the curriculum of other universities in Nigeria especially, the University of Benin and other sister institutions in the neighboring states. This is facilitated by the fact that the pioneers who put together the curriculum were mainly from the universities in the neighborhood. As a result, there is a high amount of similarities in courses arrangements and content. This call for curriculum updating is thus vital for research to be conducted into the existing tertiary curricula hence, this study was conceived to review the current curriculum of the petroleum engineering department of the Delta State University. The purpose of the study is to determine the extent the present DELSU curriculum for the petroleum engineering department is consistent with those of other Nigerian universities and to identify relevant courses that will meet both national and international challenges of the petroleum industries. At the end of the study, it is the hope of the researcher that the findings and recommendations concerning the current DELSU curriculum will be beneficial to stakeholders in curriculum developers in Nigeria, the students, the educational institutions offering petroleum engineering as a program.

Methodology

Research Design

The study adopted a Qualitative Data Analysis (QDA) and expo-factor approach. The rationale behind this design is that issues about developing a curriculum have more to do with experience and existing facts rather that opinion. To develop a curriculum there must be an evaluation of the existing curriculum to be able to identify what needs to be included or removed from the existing learning objectives contained in the curriculum and the relevance to current national needs. Qualitative Data Analysis, is a research design that deals with the analysis of extensive literature and draw inferences based on the analysis. Expo-factor research makes use of data that has been confirmed either by research or information that has been put into operation or use such as population figures, examination results, well production data, crude export figures, and so on. In this study, curricula for petroleum engineering of three universities offering petroleum engineering programs in Nigeria including, DELSU, UNIBEN, UNIPORT were collected, collated, and analyzed. This

is to determine the differences (if any) in program duration, course allocation, course units, course contents, and consistency of program content. Curriculum Data from international universities including those of OPEC countries as a university of Kuwait, University of Islamabad were also selected.

The literature on selected local and international universities curriculum for petroleum engineering and for comparative analysis they are classified into cases:

Case 1. Integrated Curricula of the three selected Nigerian Universities

The following Table 1 represents the curriculum of each of the selected universities for this research.

Table 1

Year One: (100L) Petroleum engineering Course contents and units

(NA = Not Available & S= Sub-Topic)

	Institution		**Delsu** Unit	**Uniben** Units	**Uniport** Units
1	GST.101	Use of English and library	2	2	3
2	GST.102	Philosophy and logic	2	2	2
3	PHY.101	General physics 1	3	3	3
4	PHY.102	Experimental physics	2	3	1
5	CHM.101	General Chemistry I	3	3	3
6	MTH.101	Elementary mathematic I	3	3	3
7	MTH.102	Elementary mathematics II	3	3	3
8	GST.111	Nigerian people and culture	2	2	2
9	GST.112	Peace studies and conflict resolution	2	2	2
10	GST.114	Communication in French	2	0	0
11	CHM.111	General Chemistry II	3	3	3
12	CHM.112	Experimental chemistry	2	3	3
13	PHY.112	Elementary mathematics III	3	3	3
14	MTH.111	Elementary mathematic IV	3	3	0
15	MTH.112	General Physics I	2	2	3
16	PHY.111	Experimental Physics II	2	4	1
17		Vibration Wave and Optics	S	2	3
			39	43	38

Adapted from student's handbook of selected universities in Nigeria 2010 - 2013

Table 1 above represents the curricula of the three Nigerian universities used as a case study for evaluation of the present DELSU curriculum for petroleum engineering. The

purpose of this data is to determine the level of consistency and disparity among the university curricula and to determine if DELSU curricula for petroleum engineering is in line with other Nigerian universities. Further curricula on the data are made. In all, a total of 17 basic subjects are offered in the first year (100L) with only GST.114 (communication in French) not offered by UNIBEN and UNIPORT. While vibration, wave, and optics not offered at this level in DELSU. A range of 5-credit unit difference between the minimum units of 38 in UNIPORT and 43 units in UNIBEN.

Table 2

Year Two (200L) Petroleum engineering Courses and units

	Institution		**Delsu** Unit	**Uniben** Units	**Uniport** Units
1	ENG.201	Engineering Mathematics I	3	2	3
2	ENG. 202	Engineering Mechanics I (static)	2	3	3
3	ENG.203	Strength of Materials	2	3	2
4	ENG.204	Engineering Drawing, I	3	3	2
5	ENG.205	Electrical Engineering, I	2	3	3
6	ENG.206	Technology theory and practice I	2	2	3
7	ENG 207	Engineering in the society	2	2	1
8	ENG.208	Introduction to computer programming	3	2	2
9	PGE.201	Fundamental of petroleum engineering	2	2	0
10	ENG.211	Engineering mathematic II	3	4	2
11	ENG.212	Engineering Mechanics II (Dynamics)	2	3	3
12	ENG.213	Material science	2	3	2
13	ENG.214	Engineering Drawing II	3	3	2
14	ENG.215	Electrical engineering II	2	3	3
15	ENG.216	Technology theory and practice II	2	2	3
16	ENG.217	Engineering thermodynamics	2	2	3
17	ENG.218	Engineering Computer Programming	2	2	2
18	PGE.211	Intro to pet. Engineering	2	2	2
		Total Units In Section	**41**	**46**	**41**

Adapted from student's handbook of selected universities in Nigeria 2010 – 2013

The year-two (200L) curricula show no remarkable difference in terms of courses offered. However, differences may exist in terms of course contents but this not covered in the scope in this study. In all, a total of 18 courses with a minimum of 41credit units in DELSU and a maximum of 46 units in UNIBEN creating for 5 hours credit units between the minimum and maximum units for the universities. At this level of study, all but one of the 18 courses are faculty-based courses. 95% of the courses are general faculty courses but provided for one departmental course in each semester. (PGE.201, 211)

Table 3

Year Three (300L) Petroleum engineering Course contents and units
(NA = Not Available & S= Sub-Topic)

Institution		**Delsu** UNIT	**Uniben** UNITS	**Uniport** UNITS
1	Engineering mathematic III	3	3	3
2	Technical report writing	2	2	2
3	PVT (Core Analysis)	2	2	S
4	Industrial safety and Oil Pollution Control	2	2	3
5	Industrial Gas Utilization	2	S	2
6	Rock and Fluid Properties	3	S	3
7	Drilling Fluid Technology	3	2	2
8	Engineering Geology I	3	3	2
9	Engineering mathematic IV	3	3	3
10	Engineering Entrepreneurship	2	0	2
11	Petroleum Engineering Laboratory II	2	2	1
12	Energy law policy	2	NA	3
13	Oil and Gas Production Technology	3	3	3
14	Drilling Technology I	3	3	3
15	Petroleum Geology	3	4	3
16	Fundamentals of Reservoir	3	NA	3
17	Community service	NA	NA	2
18	Transport phenomena I	S	S	3
	Total Units in Section	**41**	**37**	**43**

Adapted from student's handbook of selected universities in Nigeria 2010 – 2013

From Table 3 above, at this level of study, eventually, the three (3) Nigerian universities understudy, offers all 18 courses except for community service which is not offered in DELSU. The major discrepancy here is that both DELSU and UNIPORT have a total of 41 and 43 credit hours respectively while UNIBEN has 37 credit hours. The reason being that courses in s/no5, 6, 16&17, may have been integrated into related courses' content or taken at other levels of the program. There is no significant difference in terms of the number of courses and course units among the three universities at this stage or level.

Table 4

Year Four (400L) Petroleum engineering Course contents and units
(NA = Not Available & S= Sub-Topic)

Institution		**Delsu**	**Uniben**	**Uniport**
		Unit	Unit	Unit
1	Engineering mathematics v	3	3	3
2	Engineering Economics	2	3	2
3	Petroleum Engineering Laboratory III	2	2	2
4	Reservoir Engineering I	3	3	
5	well Logging	3	3	
6	Well completion and workover	2		2
7	Petroleum Refining Engineering	2	3	
8	Drilling technology II	3	3	2
		20	20	11

Adapted from students had the book of selected universities in Nigeria 2010 - 2013

From Table 4, UNIBEN does not offer well completion and workover while UNIPORT does not offer reservoir engineering, well logging, and petroleum refining engineering. These are offered at DELSU. This fact may be elective courses designed for students' choices. However, this is not contained in the handbook of the university concerned e.g. UNIPORT which offers only 5 courses with 11 units credit hours.

Table 5

Year Five (500L) Petroleum engineering Course contents and units

(M = major topic & S = sub-topic C=core course & E=elective)

Institution		**Delsu**	**Uniben**	**Uniport**
		Unit	Unit	Unit
1	Engineering law Management	2	3	2
2	Petroleum Economy and property evaluation	3		3
3	Well test analysis	3	2	3
4	Petroleum seminar	1	1	1
5	Natural Gas Engineering	2	3	2
6	Enhance oil recovery Methods	3		3
7	Reservoir Engineering II	3	3	
8	Multiphase flow in pipes	3		3
9	Computer Application in petroleum Engineering	3	3	2
10	Reservoir Rock Properties and Fluid phase Behavior	3		
11	Formation damage Assessment and Control	3		3
12	The element of reservoir simulation	3	3	3
13	Natural Gas processing	2	3	2
14	Petroleum Production Engineering	3		3
15	Offshore Technology	3		3
16	Alternative to hydrocarbon source			3
17	Pipeline technology	3		
18	Fundamentals of Rock Mechanics			3
		43	**21**	**39**

Adapted from students had the book of selected universities in Nigeria 2010 - 2013

From Table 5, it appears that UNIBEN offers nine courses during the final year. While DELSU offers a total of 16 core courses with 43 credits hours, UNIBEN offers 8 courses of a total of 21 credit units and UNIPORT offers 15 courses of 39 total credits hours. This implies that a student takes a minimum of 8 courses per semester in DELSU, 4 in UNIBEN, and 7 in UNIPORT. This also has implications for stress on the part of the student and the same impact on a few resource persons in DELSU specifically. It seems also that these courses have been replicated into smaller course contents and nomenclature.

Case 2. University of Kuwait – Petroleum Engineering Curriculum

The curriculum is designed to graduate engineers with the proper balance between theory and practice. A total of 144 credits are required for graduations distributed as follows: 21 credits as general education courses, 27 credits as basic science requirements, 28 credits as the college of engineering requirements, and 68

credits as departmental requirements. While the 27 credits in basic science requirements assure a solid background in Math, Physics, and Chemistry, the 28 credits of engineering requirements guarantee breadth and assure some engineering fundamental prerequisites needed for the pursuit of a petroleum engineering degree. The 68 credits required by the department are distributed to cover the three principal disciplines of Petroleum engineering, namely Reservoir Engineering, Drilling Engineering, and Production Engineering. In-depth coverage of the area of Reservoir engineering is assured by offering eight courses equivalent to 24 credit hours related to this particular area. The design element in this curriculum is supported by a cornerstone design course taken by students in their fifth semester on campus, and a capstone design course taken in the last semester. The program is supported by six laboratories, namely: PVT, Subsurface mapping, Reservoir Rocks, Drilling Mud and Cement, Well Logging, and Research Laboratories. General Education Courses (These courses are regarded by the university as general education courses which are made compulsory for students at any stage of the program, usually at the first year) as shown in Table 6 (Source: University of Islamabad official website – 2014),(Source: University of Kuwait official website – 2014) and Source: University of United Arab Emirate official website - 2014

Table 6: Courses title and units (1st& 2nd Semesters – year 1 to year 4)

University of Islamabad	**Unit**	**University of Kuwait**	**Unit**	**UAE**	**Unit**
COURSE TITLE		**COURSE TITLE**		**COURSE TITLE**	
Semester-I& 11 (year one)				Fall Semester	
Functional English	2	**General Education Courses**		General Chemistry1	4
Islamic Studies	2	Compulsory (12 Credits)		Communication 1	4
Fundamentals of Petroleum Engineering	3	Modern and Contemporary History of Kuwait	3	Freshman Success Seminar	1
Applied Physics	4	Arab and Islamic Civilization (or equivalent)	3	Calculus 1	4
Applied Mathematics-I	3	Intermediate Writing Skills	3	Overview of the	3

				Petroleum ind	
Workshop Practices	2	Technical Writing	3	Personal Health & Fitness 1	0.5
Pakistan Studies	2		**12**		**16.5**
Applied Geology	4	**Mathematics and Basic Science Courses (27 Credits)**		Spring Semester	
Applied Chemistry	4	Calculus I	3	General Chemistry ii	4
Applied Mathematics-II	3	Calculus II	3	Communication ii	4
Engineering Drawing & Graphics	2	Linear Algebra	3	Calculus ii	4
Communication Skills	2	Calculus III	3	Physics I Mechanics	4
	33	Ordinary Differential Equations	3	Personal Health & Fitness 1	0.5
Semester-III& IV (Year Two)		General Chemistry	3		**16.5**
Stratigraphy and Structural Geology	3	General Chemistry Lab	1	Fall Semester	
Computer Programming and Software applications	3	Physics I	3	Reservoir Engineering i	3
Introduction to Electrical Engineering	3	Physics Laboratory I	1	Principles of Economics	3
Applied Mathematics-III	3	Physics II	3	Sedimentary Petrology	4
Fluid Mechanics	3	Physics Laboratory II	1	Drilling Engineering, I	3
Technical Writing & Presentation Skills	2		**27**	Well Logging	3
Drilling Engineering-I	4				**16**
Applied Thermodynamics	3	**College of Engineering (faculty) Requirements (21 credits)**		Spring Semester	
Applied Statistics	3	Introduction to Engineering	0	Petroleum Econ.	4

				& Risk Analysis	
Pet. Geology & Geophysical Exploration	4	Engineering Graphics	2	Reservoir Engineering II	4
Mechanics of Materials	3	Computer Programming for Engineers	3	Completion and Workover	3
	34	Electrical Engineering Fundamentals	3	Drilling Engineering II Lectures	2
Semester-V&VI (Year three)		Electrical Engineering Fundamentals Lab	1	Drilling Engineering II Lab	1
Petro physics	4	Thermodynamics	3	Reservoir Reservoir Charization	3
Properties of Reservoir Fluids	4	Engineering Economy	3		**17**
Drilling Engineering-II	4	Engineering Probability and Statistics	3	Fourth Year Senior Year	
Applied Numerical Methods	3	Numerical Methods	3	Fall Semester	
Social Sciences	3		**21**	Well Testing***	3
Well Logging	3	**Major requirements (75 credits)**		Production Facilities	3
Reservoir Engineering	4	Workshop	1	Production System Des & Anal	3
Petroleum Production Engineering-I	3	Statics	3	Technical Elective 1	3
Natural Gas Engineering	4	Strength of Materials	3	Islamic Studies	3
Environment and Safety Management	3	Introduction to Petroleum Engineering	3	Petrol Engng Design Project 1	1
Semester-VII& VIII (Year Four)	**35**	Reservoir Rock Properties	3		**16**
Well Testing	4	Fluid Mechanics	3	Technical Elective II	3

Petroleum Production Engineering-II	4	Introduction to Petroleum Engineering Design	3	H & SS Elective I	3
Gas Reservoir Engineering	4	Reservoir Rock Lab	1	H & SS Elective II	3
Project Planning & Management	2	Phase Behavior of Reservoir Fluids	3	Petrol Engng Design Project II	3
Instrumentation and Process Control	4	Reservoir Engineering	3		**12**
Project	0	PVT Lab	1		
Principles of Enhanced Oil Recovery	4	Drilling Engineering	3		
Reservoir Simulation	4	Mud and Cement Lab	1		
Petroleum Economics	3	Petroleum Geology	3		
Petroleum Refinery Engineering	4	Subsurface Mapping	1		
Project	2	Well Logging	3		
	17	Well Logging Lab	1		
		Petroleum Production Engineering	3		
		Natural Gas Reservoir Engineering	3		
		Secondary Recovery	3		
		Well Testing	3		
		Production Equipment Design	3		
		Numerical Methods in Petroleum Engineering	3		
		Petroleum Economics	3		
		Industrial Training	3		
		Petroleum Engineering Design	3		
			66		
		Required Courses outside the Department (3 credits)			
		Geology	3		

		Elective Courses (6 credits)			
		Fluid Flow in Porous Media	3		
		Reservoir Engineering II	3		
		Formation Evaluation	3		
		Advanced Well Completion	3		
		Industrial Safety for Oil Field Operations	3		
		Offshore Technology	3		
		Storage and Transportation of Crude Oil and Gas	3		
		Oil Field Corrosion and Corrosion Control	3		
		Reservoir Modeling	3		
		Thermodynamics and Phase Behavior of Petroleum fluids	3		
		Fractured Reservoir Characterization	3		
		Transport Phenomena in Geo-Systems	3		
		Rock Mechanics in the Oil Industry	3		
		Directional Drilling	3		
		Horizontal Well Technology	3		
		Drilling in Abnormal Pressure Zones	3		
		Advanced Well Control Operations	3		
		Practical Advances in Drilling Engineering	3		
		Natural Gas Sweetening and Dehydration	3		
		Well Stimulation	3		
		Introduction to Geostatistics	3		
		Senior Project	3		
			66		
Grand total units	**137**				94

From Table 6, the University of Islamabad offers only 12 core cores in the first year with a total of 33 units. It is also significant to note that most of the basic courses are done as applied rather than elementary there are only four general and eight basic courses. It is observed from Table that faculty and departmental courses start at the first year of entry into the petroleum engineering program. From the table, the course may not be significantly different from those of the Nigerian universities already discussed, but content differences may be significant. However, could be observed that at this stage the emphasis is more of applied concept than pure theoretical approach. For instance, calculus I, II& III in addition to algebra and differential equations. Here the total units covered by basic courses are 27 compared to those of the Nigerian curriculum covering at least 37 units. Nigeria seems to do more of basic courses than that Kuwait with minimal mathematical courses and more of humanity (Source: University of Islamabad official website – 2014)

Case 3. University of Islamabad – Petroleum Engineering Curriculum

The first column of Table 6 are courses contained in the curriculum as presented by the Committee and operational in the University of Islamabad. At this stage, it is noted that mathematical courses have ended with the first year giving way to basic engineering courses that takes root from or dependent on the mathematical principles already learned in the first year thereby avoiding replication of mathematical courses at higher levels at is it in the Nigerian cases. Every course at this stage has a minimum of 3 credit hours amounting to 34 units for the section as shown in Table 6. Courses are not replicated in the semesters

Year 3 and year 4 of the Islamabad petroleum program dwell of departmental core courses with minimal courses for the relevant department.

Results and Discussion

From the data collected in the literature on the curriculum of the Nigerian universities, it is observed that there are areas of consistency and differences as presented in Table 7.

Table 7

Year One (100L) Petroleum engineering Course contents and units

(mt = major topic & st = sub-topic c=core course & e=elective)

	Institution		**Delsu**			**Uniben**			**Uniport**		
			Unit	Major/ subtop	Core/ Elect	Units	Major/ subtop	Core/ elective	Units	Major/ Subto	Core/ Elect
1	GST.101	Use of English and library	2	M	C	2	M	C	3	M	C
2	GST.102	Philosophy and logic	2	M	C	2	M	C	2	M	C
3	PHY.101	General physics 1	3	M	C	3	M	C	3	M	C
4	PHY.102	Experimental physics	2	M	C	3	M	C	1	M	C
5	CHM.101	General chemistry I	3	M	C	3	M	C	3	M	C
6	MTH.101	elementary mathematic I	3	M	C	3	M	C	3	M	C
7	MTH.102	Elementary mathematics II	3	M	C	3	M	C	3	M	C
8	GST.111	Nigerian people and culture	2	M	C	2	M	C	2	M	C
9	GST.112	Peace studies and conflict resolution	2	M	C	2	M	C	2	M	C
10	GST.114	Communication in French	2	M	C	0			0		
11	CHM.111	General chemistry II	3	M	C	3	M	C	3	M	C
12	CHM.112	Experimental chemistry	2	M	C	3	M	C	3	M	C
13	PHY.112	Elementary mathematics III	3	M	C	3	M	C	3	M	C
14	MTH.111	Elementary mathematic IV	3	M	C	3	M	C	0		
15	MTH.112	General physics I	2	M	C	2	M	C	3	M	C
16	PHY.111	Experimental physics II	2	M	C	4	M	C	1	M	C
17		Vibration Wave and Optics		ST		2	M	C	3	M	C
			39			**43**			**38**		

Adopted from students had the book of the selected universities in Nigeria 2010 - 2013

The above information, represents the curriculum for 100L students of Petroleum Engineering in Universities in the Niger-Delta area. In all, there is a level of consistency among the curriculum of the three universities and this implies that the development of the DELSU Petroleum Engineering curriculum must have been

drawn from the other two institutions. The other two faculties of Petroleum Engineering in UNIBEN and UNIPORT were in existence many years before the creation of the DELSU Engineering in 2006/2007 session. The only difference in the data in Communication in French (GST 114) not offered by the other old universities. Vibration and Optics, I, the two older faculties but are embedded in the courses of the DELSU program. Similarly, the total unit of the courses offered at this level across all faculties ranges between 38 for UNIPORT, 39 for DELSU, and 42 for UNIBEN. All courses offered as major courses and are core courses or electives.

From the statistical point of view, there is 95% course availability in all three universities, 95% core and elective courses, 90 %: 10% major topics: sub-topics and .88 coefficient of correlation in-between courses credit hours among the three universities. At this level, it can be concluded that the curricula of the three local universities are consistent in line with the research question 1

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Table 8

Year Two (200L) Petroleum engineering Courses and units

(M = major topic & S = sub-topicC=core course &E=elective)

Institution		Delsu			Uniben			Uniport		
		Unit	Major/	Core/	Units	Major/	Core/	Units	Major/	Core/
1	Engineering Mathmatics I	3	M	C	2	M	C	3	M	C
2	Engineering Mechnics I (static)	2	M	C	3	M	C	3	M	C
3	Strength of Materials	2	M	C	3	M	C	2	M	C
4	Engineering Drawing I	3	M	C	3	M	C	2	M	C
5	Eletrical Engineering I	2	M	C	3	M	C	3	M	C
6	Technology theory and practice I	2	M	C	2	M	C	3	M	C
7	Engineering in the society	2	M	C	2	M	C	1	M	C
8	Introduction to computer programming	3	M	C	2	M	C	2	M	C
9	Engineering mathematic II	3	M	C	4	M	C	2	M	C
10	Engineering Mechanics II (Dynamics)	2	M	C	3	M	C	3	M	C
11	Material sience	2	M	C	3	M	C	2	M	C
12	Engineering Drawing II	3	M	C	3	M	C	2	M	C
13	Eletrical engineering II	2	M	C	3	M	C	3	M	C
14	Technology theory and practice II	2	M	C	2	M	C	3	M	C
15	Engineering themodynamic	2	M	C	2	M	C	3	M	C
16	Engineering Computer Programming	2	M	C	2	M	C	2	M	C
	Total Units In Section	**37**			**42**			**39**		

Adapted from students had the book of selected universities in Nigeria 2010 - 2013

From Table.8 above, DELSU has 37 units while UNIBEN has a maximum unit of 42. All courses are also core courses and offered as a major course with course code but not subtopic. At this level, it is noticeable however that ENG 201 and ENG 211 are offered at 3 units which are both similar and introduction to a computer which is MTH 200 is also offered at this level as ENG 218 and 2 units. It is noticeable as well as ENG 206 and ENG 216 is offered at 200L were repeated in the second semester with course content that is not quite distinctive or voluminous. There is also a high consistency of .96 coefficient of correlation at this level of study.

Table 9

Year Three (300L) Petroleum engineering Course contents and units

(M = major topic &S = sub-topic C=core course & E=elective)

	Institution	**Delsu**			**Uniben**			**Uniport**		
		Unit	Major /	Core/	Units	Major /	Core/	Units	Major /	Core/
1	Engineering mathematic III	3	M	C	3	M	C	3	M	C
2	Technical report writing	2	M	C	2	M	C	2	M	C
3	PVT (Core Analysis)	2	M	C		S			S	
4	Industrial safety and Oil Pollution Control	2	M	C		S		3	M	C
5	Industrial Gas Utilization	2	M	C		S		2	M	C
6	Rock and Fluid Properties	3	M	C		S		3	M	C
7	Drilling Fluid Technology	3	M	C	3	M	C	2	M	C
8	Engineering Geology I	3	M	C	3	M	C	2	M	C
9	Engineering mathematic IV	3	M	C	3	M	C	3	M	C
10	Engineering Entrepreneurship	2	M	C	0	M	C	2	M	C
11	Petroleum Engineering Laboratory II	2	M	C	2	M	C	1	M	C
12	Energy law policy	2	M	C		S		3	M	C
13	Oil and Gas Production Technology	3	M	C	3	M	C	3	M	C
14	Drilling Technology I	3	M	C	3	M	C	3	M	C
15	Petroleum Geology	3	M	C	4	M	C	3	M	C
16	Fundamentals of Reservoir	3	M	C		S		3	M	C
17	Community service		S			S		2	M	C
18	Transport phenomena I		S			S		3	M	C
	Total Units in Section	**41**			**28**			**43**		

Adapted from students had the book of selected universities in Nigeria 2010 - 2013

From Table 9, UNIBEN offered less major course than DELSU and UNIPORT. This is as a result of UNIBEN taking Engineering Entrepreneurship as a necessary course with zero units. In DELSU, it is also a necessary course but units were attached which is not used in result computation thus denying students spaces for which other courses could be added or expanding the existing course unit. It is also observed that Engineering geology (CVE 305) and Petroleum geology (PGE 315). At this level, the level of consistency in courses dropped significantly to 65%, while the level of association or correlational coefficient of .66 was established.

Table 10

Year Four (400L) Petroleum engineering Course contents and units

(M = major topic & S = sub-topic C=core course & E=elective)

Institution		Delsu			Uniben			Uniport		
		Unit	Major/ subtop	Core/ Elective	Units	Major/ subtop	Core/ elective	Units	Major/ subtop	Core/ Elective
1	Engineering mathematic v	3	M	C	3	M	C	3	M	C
2	Engineering Economics	2	M	C	3	M	C	2	M	C
3	Petroleum Engineering Laboratory III	2	M	C	2	M	C	2	M	C
4	Reservoir Engineering I	3	M	C	3	M	C		s	
5	well Logging	3	M	C	3	M	C		s	
6	Well completion and workover	2	M	C	S	s		2	M	C
7	Petroleum Refining Engineering	2	M	C	3	M	C			
8	Drilling technogy II	3	M	C	3	M	C	2	M	C
		20			20			11		

Adapted from students had the book of selected universities in Nigeria 2010 - 2013

At this level, both DELSU and UNIBEN offered 20 units core course while UNIPORT offered 11 units before proceeding on Six months I.T as shown in Table 10. Courses not offered by the same universities are mainly subtopics in other courses. Whereas both UNIBEN and DELSU has 20 units each, but UNIBEN do not offer PGE 404 (well completion and workover). UNIBEN is differentiated here with the attendant number of courses it offers at this level of study. At 400L, UNIBEN offers 5 courses of 11 credit load. UNIPORT is differentiated here with the

number of courses offered at this level, which is, five (5) courses and a credit load of 11 units.

Table 11

YEAR FIVE (500L) Petroleum engineering Course contents and units

(M = major topic &S = sub-topic C=core course & E=elective)

INSTITUTION		**DELSU**			**UNIBEN**			**UNIPORT**		
		Unit	Major/	Core/	Units	Major/	Core/	Units	Major/	Core/
1	Engineering law Management	2	M	C	3	M	C	2	M	C
2	Petroleum Economy and property evaluation	3	M	C		S	C	3	M	C
3	Well test analysis	3	M	C	2	M	C	3	M	C
4	Petroleum semminer	1	M	C	1	M	C	1	M	C
5	Natural Gas Engineering	2	M	C	3	M	C	2	M	C
6	Enhance oil recovery Methods	3	M	C		S	S	3	M	C
7	Reservoir Engineering II	3	M	C	3	M	C		S	C
8	Multiphase flow in pipes	3	M	C		S	C	3	S	C
9	Computer Application in petroleum Engineering	3	M	C	3	M	C	2	v	C
10	Reservoir Rock Properties and Fluid phase Behaviour	3	M	C		S	S		S	E
11	Formation damage Assessment and Control	3	M	C		S	S	3	S	E
12	Element of reservoir simulation	3	M	C	3	M	C	3	M	C
13	Natural Gas processing	2	M	C	3	M	C	2	M	C
14	Petroleum Production Engineering	3	M	C		S		3	M	C
15	Offshore Technology	3	M	C		S	C	3	M	C
16	Alternative to hydrocarbon source		S	C		S		3	M	C
17	Pipeline technology	3	M	C		S	SC		S	C
18	Fundamentals of Rock Mechanics							3	M	C
		43			**21**			**39**		

Adapted from students handbook of selected universities in Nigeria 2010 - 2013

In Table 1 from the data provided in the curriculum of the fifth year of the program, DELSU 43 units, UNIBEN 18 units, UNIPORT 39 units. Reason for the great discrepancy between total units taken at this level in UNIBEN ant that of DELSU and UNIPORT is that in DELSU and UNIPORT courses such as PGE 509, PGE 514, PGE 501, PGE 513 were already taken at a lower level in UNIBEN which are replicated in DELSU and UNIPORT. And are replicated in DELSU and UNIPORT and PGE 511,

505, 517, 518, and 513 may have been taken as subtopics in the contents of the general course of another allied course. This finding implies that while UNIBEN can expand its curriculum, DELSU and UNIPORT will have to integrate some of these allied courses and course content to be able to accommodate new courses arising from Research and Development (R&D) and new technology and techniques. For instance, the present curriculum of drilling technology should accommodate 3-D technology. The same applies to other areas of Petroleum Engineering.

Comparative analysis of international universities curriculum for petroleum engineering

Table 12
summary of some courses and units offered in selected universities

	Islamabad		**Kuwait**		**Uae**		**Nigeria**	
Prog. Duration (YR)	**4**		**4**		**4**		**5**	
	No. of Cours	Total Unit	No. of Cours	Total Unit	No. of Cours	Total Unit	No. of Cours	Total unit
General education courses	3	8	3	9	4	9	5	10
Basic Science courses	7	27	11	27	11	30	12	29
Faculty requirement	17	29	9	21	7	21	19	35
Major requirement	16	48	26	75	17	42	42	107
Electives	0	0	21	6	4	12	0	0
Other departments	437	22	1	3	5	16	2	4
TOTAL	**50**	134	**71**	141	**48**	**130**	**80**	**185**

The above Tables 12. That is, the table represents the program structure of the universities named in the table. While the maximum number of courses offered at the foreign universities is 141 for the program duration, Nigerian universities have operated up to 185 courses. A difference of a minimum of 41 courses. The question here is that, where there are extra courses drawn from. A review of Table 7 and 12, it is evident that some courses in the Nigerian universities nay DELSU have been excessively partitioned e.g. Elementary mathematics, Elementary physics, Engineering mathematics, etc. such that comparatively, a 3 unit course in a foreign university has a minimum of 4 units in one academic year and up to 16 units in the entire program. Similarly, see the table below. At the third (300L) and fourth year (400L). The advantage gained by international universities in this direction is three-fold.

Summary of the major findings and implication for program efficiency

1. *Too much emphasis on general and elementary courses*

   At the 100L in the DELSU curriculum, courses such as GST's has a total of 10 credit load out of the 39 units, leaving basic courses for 29 units. This is not so in those of the advanced petroleum nations mentioned. Similarly, elementary courses offered by faculty courses are oversimplified. Consider table 24, the University of Islamabad offering applied Mathematics, Applied Physics, Introduction Petroleum Engineering, Applied Geology, and Applied Chemistry or the University of Kuwait offering Calculus, Linear algebra, and Engineering Graphics or Texas A, M university offering Foundation of Engineering, Eng. Mathematics and Mechanics, all at 100 level compared to Nigeria. This provides a strong background for entry into other core courses at higher levels.

2. *Over replication of courses (table 23 & 24)*

   In DELSU, at 100 level, there are four elementary mathematics courses of 2 credit units, four elementary physics of 10 credit units, four elementary courses of 10 units, inclusively amounting to 39 units of credit hours. The case is not significantly different at 200L where only one core petroleum engineering course (PGE 201/211) was provided for each semester. This is significantly different from foreign universities where more core departmental courses are provided.

3. *Lack of elective courses*

   As a result of the over-replication of some of the courses, DELSU Petroleum and Gas Engineering, with a total of 80 courses of 185 credit units, the curriculum could not accommodate some very crucial courses such as courses relating to a specific area of interest e,g gas related courses as reflected in the department nomenclature (petroleum & gas engineering) and others such as Geostatistics, Seismography, etc. This is not the case with the international universities used in the study. For instance, the University of Kuwait made provision for at least 16 elective courses of a total of 66 credit hours from which students take 2 courses (see table 9).

The implication of the findings

1. *Effect on human resources*

   The over-splitting of courses places a demand for more lecturers (*that are not readily available*) on the university as well as the excess workload on the available lecturers. As a result, lecturers are prone to stress as well as the implication for accreditation.

2. *Inability to complete course content*
   The workload arising from the numerous courses allocated to a single lecturer may lead to an inconclusive scheme of work thereby depriving the students of complete knowledge of the subject matter. Again, it places a serious challenge on a student as the graduate into the labor market and world of entrepreneurship.

3. *Inability to accommodate new knowledge into the curriculum*
   The finding also has a consequence for updating course contents in the light of current challenges and knowledge arising from innovations, advancement in science and technology, and research.

Conclusion

A comparative study indicates that there is a big gulf in the program structure of the two sets of university programs, and this has implications for the course duration, course content coverage, and insufficiency of academic staff and late exposure of students to core Petroleum exporting countries. Recent trends in Petroleum engineering are not covered in the curriculum of the DELSU Petroleum Programme.

Recommendations

In light of the research findings, the researcher recommends thus:

1. Reduction in the general courses offered in the first year to accommodate some introductory departmental courses.
2. The curriculum should be review to integrate some of the replicated courses and contents and provide for some core courses to be taught at lower levels thereby exposing students early enough to petroleum engineering rather at a higher level.
3. The basic engineering courses should be strengthened to accommodate the application of concepts, theories, principles, and laws rather than elementary emphases.
4. Basic entry qualification for entry into the petroleum and gas engineering program should be reviewed to include a compulsory credit pass in additional mathematics that provides the fundamental of engineering mathematics rather than the sole reliance on general mathematics.
5. To strengthen the program resources such as human, infrastructural, and instructional needs as a key consideration for curriculum viability, implementation, attainment, and accreditation need.
6. Arising from the implementation of the above, the program can be reviewed to run for four years as in universities of Islamabad, Kuwait, United Arab Emirates, Texas, and Alaska, and so on.

Contribution to Knowledge

The outcome of this study has made it possible for Petroleum and Gas Engineering, the Faculty, DELSU, and stakeholders in curriculum development to know the status of the current petroleum and gas engineering curriculum. The research has made us know the differences in the local curriculum and those of the international countries, in terms of course replication, too much emphasis on elementary and general courses to the detriment of the core petroleum courses at the early stage of the program. This knowledge will greatly assist the faculty in taking appropriate actions to restructure.

The implication for further studies

The outcome of the study raised an argument as to the viability of the existing DELSU engineering program. Therefore research into the competency differential between the graduates of the Nigerian 5-year petroleum engineering degree program curriculum and those of the foreign universities operating 4-year petroleum engineering degree program.

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