A CRITICAL STUDY OF STRUCTURAL ADEQUACY OF PHYSICS TEACHER EDUCATION CURRICULA IN SOUTHWESTERN NIGERIA

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Abstract

This study was carried out to examine the structural adequacy of Physics teacher education curricula in Southwestern Nigeria, with the goal of establishing if the design meets the National University Benchmark on Minimum Academic Standard (NUCBMAS). The descriptive survey research design was used for the study. The instrument Physics Teacher-Education Curriculum Structural Adequacy and a Checklist (PTCSRAC) were used to elicit information for the study. Data were analysed using descriptive statistics of frequency count percentages. The study revealed that the course units assigned by the nine universities under this study were 70% adequate with the NUC standard. The result also revealed that two universities core course units were at <70% and the remaining universities were <70% to NUC standard while all the nine universities were adequate at 70% to NUC standard. It was recommended that all the universities trained secondary school Physics teachers should cooperate to produce a common curriculum structure as established by NUC for the Physics components of the teacher education programme in order to ensure a uniform preparation of secondary school Physics curriculum.

Key: Critical**,** Study, Structure, Adequacy, Curricula. Teacher education, Pre-service teacher

Background to the Study

Education has contributed immensely to increase in developing knowledge, skills and attitude towards the teaching learning processes. It builds human capital required for a potential knowledge economy. Global developments in teacher education programme and the challenging shortage of Physics teachers in Nigeria secondary school system of education however calls for research into the curricula structure of the universities offering the programme (Ojediran, 2015). Realizing the importance of curriculum structure for Physics teacher education in Nigeria, The National Policy on Education (NPE) Federal Republic of Nigeria (FRN, 2004) stated that 'since no educational system can rise above the quality of its teachers, teacher education will continue to be given a major emphasis in all the educational planning and development'. The government is also convinced that if Nigerian universities are to make optimum contributions to national development in professional fields, the course contents should reflect the nation's aspirations. These may be the reason why Nwachukwu (2008) and Nwachukwu (2012) opined that the growth of any nation to do with the level of development of science education which invariably meant that it is the only means of reducing illiteracy and poverty in a country. In corroboration to the National Policy on Education, the National University Commission (NUC, 2007), reiterated the need for trained, qualified and efficient teachers at the university level. It emphasizes the need to produce teachers who will teach Physics effectively at the secondary school level.

Offorma (2005) described the status of curriculum in any educational institution as a vehicle through which education takes place. He described the curriculum as the totality of the student environment where education takes place, the learners, the teachers, the content, the subject, the resources, the methods of teaching, evaluation

styles as well as the physical and psychological environment are involved for learning to take place. A distinctive feature of the undergraduate Physics education programme structure in Nigeria universities has division of courses into segments and units (Omosewo, 1991 and Ojediran, 2015). These units are often taught by a large range of specialists for a specified period. The unit courses are available under the areas of Mechanics, Atmospheric Physics, Electronics, Waves and Vibrations, Electromagnetic theory, Modern Physics, Quantum Physics in the various cognate faculties presented in each university's curriculum. Each course has its structure which depicts the credit point attached to it in terms of Lecture hours (L), Tutorial hours (T), Practical sections/hours (P), Units attached to it (U) (known as LTPU) (NUC, 2007). Each university has the autonomy of redesigning its courses and their codes to suit the purpose of their programmes which in turn allows each institution to design their curricula based on the National University Commission (NUC, 2007) standard known as benchmark on minimum academic standard (BMAS). In order to achieve the objectives of Physics education at the university level, laboratory activities and tutorial sections are provided for every unit of each of the Physics Teacher Education Curricula (PTEC).

Despite efforts made in the design and development of the curricula by various universities, gap is still exist in the training of teachers. These gaps have been agitating the mind of the science educators in the decades (Omosewo, 2009 and Ojediran, 2015). The existing gaps in structural adequacy is a challenge to the curricula in Physics teacher education programme as found in various universities housing the programme in Southwestern Nigeria.

The Structure of Academic Discipline in Physics

University operates a complex academic oriented curriculum structure. The structure combines remarkable stability and resilience. It has an internal structure with a characterized pattern organized with an in-built mechanism for transformation of the society and individual development. Emphases on the structure of discipline are intensively established by Brunner (1974) and Schwab (1962) and the identification of Survival Logically Distinctively Forms Knowledge (SLDFK) is postulated by (Pheniz, 1964 and Hirst, 1974). The authors are of the view that disciplines such as Physics teacher-education program (PTEP) has a boundary that is simply an instrument of social control while relatively sum did not however allow the disciplines to have single logical structure of concepts, theories and generalizations. It also organizes the more specific facts in the discipline, forms of knowledge relating to the criteria of logic, methods and epistemology which are emphasized. Each university has its organized curriculum structure depending on the specific criteria and procedural bound up within the particular range of problems for content adequate, societal adequate and individual development as presented in NUCBMAS (NUC, 2007).

Ehindero (2014) viewed that curriculum structure for each discipline especially Physics teacher education programme should be such that will provide a fertile and complex framework for knowledge construction. There reacher emphasized that each child or learner should learn how to construct their knowledge models of learning and understanding within the curriculum structure of its discipline (Physics teacher education). Hence, effective construction of knowledge has a lot to do with addressing the curriculum structure of each discipline. The PTEC structure can be grouped according to the predominant kind of epistemological objectives that is pursue in terms of causal generalisation, interpretation of each course outline and evaluation. The curriculum structure should be such that will bring about developmental modes of content and of constructions (knowledge construction and interpretation of meaning by learners). Schwab (1962) explains that the structure of any discipline should focus on two broad and connected aspects: the substantive structure and the syntactical structure. The substantive structure is the pattern of the body of knowledge relating to the concepts and models it employs. The substantive process entails the discipline concepts and their related questions and issues that are required in knowledge construction and meaning-making in the classrooms. Substantive structures are formed by the basic concepts, principles or themes that organise the more specific facts in Physics. The

syntactic structure has to do with the rules and procedures in developing and testing knowledge. The syntactic structure according to Schwab (1962) in Posner (1995) establishes way scholars in a discipline such as in Physics establish truth and reality. Therefore, the researcher deduce that the difference in the conceptual schemes between or within the disciplines has attribute of syntactical structures.

The Physics teacher education curriculum is meant to train pre-service Physics teacher to teach Physics in secondary schools (NUC, 2007). The curriculum should provide a framework for student's construction of unique models of knowing the meaningful interpretation of experiences. It is organized to meet the essentials of the teachers' professional qualifications concerning the subject matters, as well as, didactical and their pedagogical competences. These will enable the Physics teachers after the training to become expert not only on the content knowledge of the subject matter but also paying attention to students' knowledge in the classrooms **(**Omosewo, 2009**).**

The studies tend to view the logical and epistemological conditions that affect the organisation of knowledge within particular structures of the curriculum. Pheniz (1964) and Hirst (1974) are the exponents of structure within disciplines which also tend to be pre-occupied with the conditions of logically systematic organisation of knowledge. Therefore, it is noteworthy that the discipline structure such as PTEC has to be philosophically backed as a collective enterprise and institutionally organized. This serves as the basis for NUC accreditation of courses for every discipline in the universities. Within the context of any discipline there is relatively frequent innovation and revision in concepts and theories, the methods and techniques although less frequently, and even the basic objectives are subjected to revision (Ehindero, 2014).

The syntactical structures such as the models, procedures, methods and rules as a proof for meaning-making an interpretation processes which make up the Physics education like any other programmes in the universities. The PTEC was structured so that the first two years of the university programme present an introduction to the major theories of Physics; classical mechanics, special relativity, electricity and magnetism, statistical physics, atomic physics, and occasionally some quantum mechanics (NUC, 2007).

During the third year of students in the university. some special branches of Physics are introduced; however, the principal objective is to master the mathematical foundations of quantum mechanics. Most other programmes such as advanced laboratory are studied in the fourth year. Practicum is a demonstration in which the students could learn how to illustrate physical phenomena and the laws of Physics as they would have to do in secondary schools. Pre-service Physics teachers receive instructions in research methodology and research in their subject studies and pedagogical studies with certain credit units or hours assigned to it for them to qualify as Physics teachers. A minimum of 86 credits hours for Physics related courses (core courses, restricted electives courses and laboratory courses) are obligatory for qualification under four years of preparation designed for teachers (NUC, 2007). These with a view to ensure that graduates of the programme are:

i. securely grounded in the fundamentals of Physics;
ii. sufficiently aware of curriculum changes and strictly move with the changes;
iii. prepared to discuss current ideas in Physics with their students;
iv. aware of the various sources of apparatus, how to buy, use and care for them; and
v. prepared to teach in at least one other field.

Therefore, for Physics teacher education to be of standard to produce competent teacher to teach Physics in secondary schools, substantive and syntactic structure are embedded in the course structure (core course units, specialization course units and Elective course units structure). Thus the significance of substantive and syntactical structure cannot be underestimated in the professional training of pre-service Physics teacher in Nigeria. It is against this background that there is a need to critically studied the Physics teacher education curricula in Southwestern Nigeria so as to compare the programme structured for adequate with NUCBMAS.

Statement of the Problem

Physics education is one of the teacher-education programmes in Nigerian universities'. The curricula were developed in line with the criteria established by the National University Commission (NUC, 2007) and are meant to produce competent Physics teachers for senior secondary schools. The perennial poor performance of students in Physics is worrisome and may be adduced to poorly equipped laboratories, inappropriate teaching strategies and insufficient number of quality teachers that universities produced. These may question the standard of such curricula structure and its relativity to the national standard. Studies have been carried out on issues relating to teaching methods, classroom interaction pattern in Physics classrooms, and curriculum evaluation in Nigeria, yet relative improvement in students' performance in Physics has been found (Ajayi, 2000; Mankilik, 2006; Ajayi, 2007; Ibidapo-Obe, 2007; and Abdulraheem, 2012). There is therefore the need to critically study the underlying curriculum structure for Physics teacher education in Southwestern Nigerian universities. Hence the study.

Purpose of the Study

The study examined the structural adequacy of Physics teacher education curricula in Southwestern Nigerian universities in line with National universities commission benchmark on minimum academic standard (NUCBMAS). The specific objectives of the study are to:

a. examine the relevance of Southwestern Nigerian Universities Physics teacher education curricula course units structured in line with the National universities commission benchmark on minimum academic standard.
b. examine the adequacy of the Southwestern Nigerian Universities Physics teacher education curricula core course units structured in line with the National universities commission benchmark on minimum academic standard.
c. examine the adequacy of the Southwestern Nigerian Universities Physics teacher education curricula specialization structure in line with the National universities commission benchmark on minimum academic standard.; and
d. examine adequacy of the Southwestern Nigerian Universities Physics teacher education curricula elective units structure in line with the National universities commission benchmark on minimum academic standard

Research Questions

1. Do the Southwestern Nigerian Universities Physics teacher education curricula course units structured in line with the National universities commission benchmark on minimum academic standard?
2. How adequate are the Southwestern Nigerian Universities Physics teacher education curricula core course units structured in line with the National universities commission benchmark on minimum academic standard?
3. How adequate are the Southwestern Nigerian Universities Physics teacher education curricula specialization structure in line with the National universities commission benchmark on minimum academic standard?
4. How adequate are the Southwestern Nigerian Universities Physics teacher education curricula elective units structure in line with the National universities commission benchmark on minimum academic standard?

Significance of the Study

The study will provide information on the existing gaps in course units structure, core course units structure, specialization course units structure and elective course units structure adequacy to NUC standard. These will afford the stakeholders in Physics teacher education programme the opportunity to adjust each curriculum with respect to NUCBMAS.

Methodology

The study adopted the descriptive survey design, which enable the researcher to provide systematic and accurate description of the variable of interest related to curricula issues in Physics education in the universities. The population comprises of all the universities offering Physics teacher-education programmes in Southwestern Nigerian. All the nine universities (A, B, C, D, E, F,G, H and I) that house Physics teacher-education curricula were used for the study and the Benchmark on

minimum academic standard has established by NUC (2007) were purposively used for the study because all the nine universities in the study area already had the programme accredited by NUC. The instrument for data collection was Physics Teacher - Education Curriculum Structural Adequate and Adequacy Checklist (PTECSRAC). PTECSRAC has two sections (A and B). Sections A and B are extracted from NUCBMAS and the selected universities Physics teacher-education curricula. Section A elicited the adequacy of course structure units (core courses units, restricted electives units and course specialization units). Section B considered the extract of the NUC course units/contact hours/structure for Physics courses alone. Physics teacher-education curricula structures of each university in Southwestern Nigeria were cross checked for adequate using deskwork analysis. The course structure such as core courses units, restricted electives units and specialization course units were also compared to NUCBMAS. The instrument was validated using expert judgments since it is extracted from a validated document from the universities and the NUC.

Data Analysis

The data collected were analysed using descriptive statistics of simple proportion, frequency count and percentages based on the research questions raised.

Results

Research Question One: How adequate are the structure of PTEC in Southwestern Nigerian universities in line with NUCBMAS?

In answering this question, structure of discipline as raised by Schwab (1962) was used as the basis for this study. Schwab emphasizes on both substantive and syntactical structures and these are embedded in NUCBMAS for UPTEC. It was used as the yardstick for adequate for this study.

Table 1: Content Analysis of Universities Course Units Structure Adequacy to NUCBMAS

Universities	Course Units Assigned 120/90	NUC Course Units Accrued	Remark
A	166 (96.5)	172	Adequate
B	158 (91.9)	172	Adequate
C	186 (108)	172	Adequate
D	194 (112.8)	172	Adequate
E	165 (95.3)	172	Adequate
F	88 (51.2)	172	Not Adequate
G	160 (93.0)	172	Adequate
H	123 (71.5)	172	Adequate
I	156 (90.7)	172	Adequate

Source: Extract form UPTEC, NUCBMAS (2007) Percentage in Parenthesis

Table 1 presents the Physics teacher education core course units against the NUCBMAS. It was found that the course units assigned by each university to their courses for students to graduate from Physics teacher education against the NUCBMAS for UPTEC of all the universities (A-I) listed above were adequate at above 70% except the university F with percentage (51.2%) far less than 70%.

Research Question Two: How adequate are the Physics teacher education curricula Core Course Units structure in Southwestern Nigerian Universities adequately in line with the National universities commission benchmark on minimum academic standard?

Table 2: Analysis of Universities Core Course Units Structure Adequacy to NUC Standard

Universities	Core Courses Units	NUC Core Courses Units	Remark
A	50 (96.2%)	52	Adequate
B	77 (148.1%)	52	Adequate
C	43 (82.7%)	52	Adequate
D	30 (57.7%)	52	Not Adequate
E	29 (55.8%)	52	Not Adequate
F	19 (36.5%)	52	Adequate
G	59 (113.5%)	52	Adequate
H	41 (78.9%)	52	Adequate
I	58 (111.5%)	52	Adequate

Source: *Extract from UPTEC, NUCBMAS (2007) Percentages in parenthesis*

Table 2 present the universities Core Course Units for PTEC adequacy against the NUC standard. The Universities D, E and F were not adequate to NUCBMAS while the remaining universities A,B,C,G, H and I were adequate to the NUCBMAS UPTEC standards units for Physics teacher education.

Research Question Three: How adequate are the Physics teacher education curricula specialization structure in Southwestern Nigerian Universities in line with the National universities commission benchmark on minimum academic standard?

Table 3: Analysis of Universities Specialization Course Units Structure Adequacy to NUC Standard

Universities	Specialization Credit Units	NUC Specialization Credit Units	Remark
A	63 (100%)	63	Adequate
B	54 (85.7%)	63	Adequate
C	109 (173.0%)	63	Adequate
D	123(195.2%)	63	Adequate
E	127 (201.6%)	63	Adequate
F	65 (103.2%)	63	Adequate
G	73 (115.9%)	63	Adequate
H	60 (92.2%)	63	Adequate
I	91 (144.4%)	63	Adequate

Source: *Extract from UPTEC, NUCBMAS (2007) pp 267-276 Percentages in parenthesis*

Table 3 present the Physics teacher education specialization course units to NUCBMAS. All the universities specialization course units are adequate to NUC standard.

Research Question Four: How adequate are the Physics teacher education curricula specialization structure in Southwestern Nigerian Universities in line with the National universities commission benchmark on minimum academic standard?

Table 4: Analysis of Universities Elective Course Units Structure Adequacy to NUC Standard

Universities	Electives Units	NUC Electives Units	Remark
A	63 (185.3%)	34	Adequate
B	27 (79.4%)	34	Adequate
C	32 (94.1%)	34	Adequate
D	41 (120.6%)	34	Adequate
E	09 (26.5%)	34	Not Adequate
F	04 (11.7%)	34	Not Adequate
G	28 (82.4%)	34	Adequate
H	22 (64.7%)	34	Not Adequate
I	14 (41.2%)	34	Not Adequate

Source: *Extract from UPTEC, NUCBMAS (2007) pp 267-276 Percentages in parenthesis*

Table 4 present the electives course units approved by NUC against each University's electives course units for PTEC. Result reveal that universities E (26.5%), F (11.88%), H (64.7%) and I (41.2%) were not adequate to NUCBMAS specialization course units with the percentage less than 70%. The remaining universities were adequate at above 70% to NUC standard.

Discussion

The study revealed that the total course units among the universities in terms of adequacy were 70% to NUC Benchmark. The result was not in consonant with the findings of Monk and Osborn (1996) in whose study supported Schwab's (1962) who expounded that most curriculum have forgotten the important distinction between substantive and syntactic structure which is expected to be in universities curricula. The analysis of The universities core course units structure are adequate to NUC standard, hence, the results revealed that out of nine universities curricula sampled; three universities do not adequately comply with NUC standard. Ivowi (2004) reported that the components of the science teacher-education programme should contain enough depth and breadth to enable the teacher to be adequate and effective in teaching senior secondary school Physics.

It can also be observed from the result that out of nine universities, only University A had specialization course units for PTEC less than 50 units. This according to Ivowi (1987) who expounded that as Physics teacher is expected to teach Physics in secondary school, he or she need to be equipped in specialized courses in Physics which are adequate to the needs of society and secondary schools. He exonerated courses such as special relativity, low temperature physics, geomagnetism, plasma physics among others. Whereas he emphasized on the teaching of solid state physics, modern physics (adequate aspect of atomic and nuclear physics) and elementary instrumentation as being very necessary. He then suggested that adequate specified courses will afford an opportunity for student teachers to develop interest in the course and in teaching.

Conclusion

The study concluded that there is structure inadequacies of Physics teacher education curricula (PTEC) in few Southwestern Nigerian universities. Also the larger percentage of the universities adequately observes the structure as recommended by NUC. A reasonable conclusion one can drawn is that NUC policies (NUCBMAS) are clear and consistent over the years and there is a well-designed curriculum for PTEP by NUC that aim at satisfying the needs of the society especially at the secondary school level. Going by the findings of this study and assessment of the Physics teachers produced, the conclusion reached is that the efforts of implementing the NUC standard have not been sufficiently articulated to produce the desired results.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Each of the nine universities should ensure that its curricula structure is adequate to NUCBMAS and must be unified among the universities.
2. All the universities faculties of Education should cooperate to produce common curriculum structure for Physics teacher education as established by NUC for the Physics components of the teacher education programme in order to ensure a uniform preparation of teachers for the same secondary school Physics curriculum.

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