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Evaluation of the Methodology Aspect of the Science Teacher Education Curriculum in Nigeria

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Abstract: Until now evaluation studies on teacher education have not paid sufficient attention on the methodology used in the preparation of science teachers. The science teaching strategies listed in the methodology curricula of Science Education Programmes in Nigeria and its relationship to the Pre-Service Teacher Educators (PSTEs) instructional strategies was assessed. Two instrument tagged Guidelines for the Evaluation of Official Documents on Curriculum and PSTEs'Instructional Strategies Rating Scale were used to gather data. Sixty Pre-Service Science Teachers from four universities in Nigeria, two each offering B. Ed and BSc. Ed, respectively were randomly selected for the study. Content analysis was used to determine the presence or absence of the science teaching methods included in the methodology courses. Simple percentages and linear regression were used for data analyze.

Key words: Teacher education, methodology aspects, instructional strategies, education programmes, evaluation studie, Nigeria

INTRODUCTION

One of the aims of university education in Nigeria is to contribute to national development through high-level relevant manpower training (FRN, 2004) and Science Education is viewed as a means of producing scientists needed for national development. Hence the National Policy on Education (FRN, 2004) states that Science Education shall emphasize the teaching and learning of science processes and principles. This will lead to fundamental and applied research in the sciences at all levels of education. The specific objectives of the National Science, Technology and Vocational Education programmes therefore include:

- To cultivate inquiring, knowing and rational mind for the conduct of a good life and democracy
- To produce scientists for national development
- Service studies in technology and the cause of technological development and
- Provide knowledge and understanding of the complexity of the physical world, the forms and the conduct of life

The National Policy further emphasized that Government shall popularize the study of the sciences and the production of adequate number of scientists to inspire and support national development. This point to the high level of importance which government places science education, particularly science teaching that employs the methods of inquiry. The policy emphasizes that the National objectives of teacher education shall include among others:

- To produce highly motivated, conscientious and efficient classroom teachers for all levels of our education system
- Encourage further the spirit of Inquiry and creativity in teachers

Achievement of these stated objectives depends on provision of quality teacher education programmes, including rich curriculum content used in the programmes. Quality teacher education in the context of this study, implies how well the content of the science methodology curriculum used in the preparation of science teachers in tertiary institutions in Nigeria fits the National objectives of Science Education.

A curriculum is the set of courses, prospectus, programme of study or syllabus offered at a school or university (English Thesaurus). Hence a curriculum

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includes the range of courses from which students choose the subject matter to be studied in a particular programme as well as the teaching and assessment strategies to be used for those courses. Curriculum can also be seen as all the activities that are geared towards the achievement of educational goals (UNESCO, 1998; Babalola and Jaiyeoba, 2008). The curriculum therefore ought to include all the activities and resources that are expected to be part of the teaching learning process, such as the instructional materials to be used, the time particular aspects of learning should take place, teacher professionalism and the teaching/learning approaches to be employed. From the fore going it is expected that the content of the science methodology of the curriculum of tertiary educational institutions should spell out the specific teaching and assessment strategies needed for teachers to carry out their duties after graduation.

The National Policy on Education (FRN, 2004) views education as an instrument for National development, hence the curriculum content especially that of tertiary institutions is meant to be dynamic in order to meet the needs of the larger society. Babalola and Jaiyeoba (2008) cited some reasons for curriculum development in higher education which include the incorporation of current and relevant content matter into existing curriculum, placing higher education in its local setting from the western context, filling the gaps that exist in higher education programmes, responding to the needs of the society as dictated by the world trends and responding to research evidence from the Education Sector Analysis (ESA) of the higher education sub-sector.

It has also been observed that the type of curriculum designed for Nigerian schools is the spiral curriculum and the constructivism approach to spiral curriculum provides that children should learn by discovering things for themselves (Adikwu, 2008). In his view, Adikwu (2008) opines that the world's Declaration of Education For All was not simply to make school available to all but to also promote the type of quality education that provides the tools, knowledge, skills, values and attitudes required by human beings to be able to survive. Such quality of education has the capacity for developing the full potentials of learners to live and work in dignity; participate fully in development improve the quality of their lives make informed decisions and to continue to learn. This implies that the curriculum content of the tertiary institutions needs to have in them specific skills, knowledge and values to be acquired by its graduates as well as the right attitudes of mind required of them to function in the society in order to live meaningfully and contribute to the development of themselves and the society they live in.

Unfortunately, as declared by UNESCO (1998) several years ago, traditional subjects and practices abound and remain unquestioned in Nigerian Universities. This includes teacher education programmes in Nigerian universities. Babalola and Jaiyeoba, (2008) made similar observations that in Nigeria, higher institutions of learning have remained unchanged in their curriculum offerings. These views were also substantiated by the former Executive Secretary of the National Universities Commission (NUC) who asserted that no matter how good the curriculum mounted by the NUC was, there was ample evidence that universities in Nigeria were not implementing the government initiated syllabuses as expected (Okebukola, 1998). In the view of Adikwu (2008), the curricula in Nigeria are outdated, hence calls for a review specifically, the science curricula in order to make them relevant. He declared that there is urgent need for curriculum development, especially in the sciences to be in line with the Millennium Development Goals if Nigeria is not to be left behind in the globalization process.

Literatures abound on theories of teaching and learning especially in science classes as every subject has techniques and methods that are unique to its teaching and learning. The teaching and learning of science in an ideal classroom is expected to be done following the processes proposed and used by scientists. Effective use of the strategies by science teachers leads to the acquisition of science process skills by the students. The Federal Government of Nigeria in the National Policy on education recognized this and spells out clearly that one of the National education goals is the acquisition of appropriate skills, mental, physical and social abilities and competencies that will equip the individual to live in and contribute to the development of the society. Therefore the main goals of science education shall be to cultivate inquiry, knowing and rational mind for the conduct of a good life and democracy as well as to produce scientists for National development (FRN, 2004). The place of science in the development of any nation cannot be over emphasized as the level of development of any nation is now determined by the level of scientific activities being practised by its indigenes.

Some of the teaching strategies that have been recommended for science teachers to inculcate science process skills in their students include demonstration, direct observation, field trip, group work, laboratory activities manipulations, modelling, reading and seminar (Ibe and Nwosu, 2003). These writers advocated that science should be taught through hands-on method approaches where students are placed in problem solving situations and surrounding them with appropriate materials that will enable them process information to

solve scientific problems. This view conforms with the recent emphasis of the Federal Ministry of Education on the use of field studies, guided discovery, laboratory techniques and skills coupled with conceptual thinking as major teaching strategies for the implementation of the Senior Secondary School Biology Curriculum.

Despite the foregoing recommendations, studies have shown that teachers have consistently stuck to the lecture method of teaching as the major strategy in science classroom teaching (Ibe and Nwosu, 2003). In a study by Ibe and Nwosu (2003) to determine the effect of guided inquiry and demonstration on science process skills acquisition in biology, it was found that the group taught with guided inquiry method performed significantly better than those taught with the demonstration and conventional methods. They therefore recommended that since guided inquiry methods of teaching helps to acquire science process skills which enhance the understanding of science concepts, teachers should adopt the method in the teaching of science.

In Nigeria, many researchers have reported about students' poor performance in secondary school science subjects in external examinations (Nwagbo, 1999) and this has been linked to teachers' poor methods of teaching. As earlier indicated, teachers prefer to use the traditional lecture/expository method instead of engaging in innovative activity-based methods that engage students in hands-on and minds on activities like the discovery concept mapping, laboratory approaches and co-operative learning.

The possibility that teacher educators may share in this practice of use of poor teaching methods could have far-reaching implications in Nigeria's educational system. Most times teachers teach the way they were taught. Johnson (2004) posited that most teachers were not taught using the inquiry method since they themselves did not have the opportunity to learn science using the inquiry method, nor have they conducted scientific inquiries themselves.

Osuafor (1999) also ascertained empirically that most science teachers in Nigeria have no knowledge of how to effectively utilize innovative science teaching strategies such as experimentation, project method, concept mapping and field trips/excursion. These findings raise questions about quality of Teacher Education Programmes in Nigeria and how well science teachers are prepared to handle science teaching with current, innovative and effective strategies. For instance, the teachers who participated in Osuafor's study could not identify what instructional analogy and concept mapping were all about. A central issue in this study is whether the methodology curriculum being implemented in the Teacher Education programmes is what was intended and if it is it being attained? Three levels of curriculum summarized in the reports of the Second International Mathematics Study (McKnight *et al*., 1987) include the following:

The intended curriculum: This consists of the topics that the teachers are expected to teach. It is made up of the approved course content by the school authorities and are stated in the curriculum guide for lecturers and students.

The implemented curriculum: This is how the teachers translate the intended curriculum into practice. It is the part of the intended curriculum that is actually taught by the teachers, the instructional practices used, instructional materials used and the way the teacher manage the entire classroom setting to ensure meaningful learning by the students. This is what actually determines what the students have learnt.

The attained curriculum: This is what students learn as represented by their scores in assessment instruments. It is the final product of that part of the intended curriculum that was implemented.

The foregoing observations therefore call for an evaluation of the curriculum of the science teacher education programme, especially its methodology component.

Objective of the study: Studies have shown that the prevalent science teaching method in Nigeria is the lecture method. Most studies on how to improve the science teachers' teaching methods have based on the efficacy of different teaching strategies. Not much have been done on the initial preparation of the science teachers and how to improve on the curriculum used for their preparation. This study is designed to investigate the specific science teaching skills, intended and implemented for pre-science teachers as listed in the science methodology courses of participating science education programmes in Nigeria as well as their influence on the PSTEs instructional strategies.

MATERIALS AND METHODS

Research questions: This study therefore seeks to answer the following questions:

- What are the specific science teaching strategies listed to be taught in the science methodology courses in the BSc. Ed and B. Ed programmes?

- What are the patterns of use of instructional strategies by Pre-Service Science Teacher Educators (PSTEs) in B. Ed and BSc. Ed Science Education programmes?
- Is there any relationship between the teaching strategies listed in the curriculum and the teaching strategies of the PSTEs?
- What is the composite predictive strength of the listed science teaching strategies on the PSTEs' instructional strategies?
- What is the relative predictive strength of the listed science teaching strategies on the PSTEs' instructional strategies?

Scope of study: This study is designed to cover a total of four tertiary institutions in two geo-political zones of the country. Two of these institution run B. Ed and BSc. Ed programmes, respectively.

Research design: The survey research design is used in carrying out this study. There is no manipulation of variables. The differences between the groups if any have already occurred due to the different programmes run. The researcher simply studied the situations on ground and reported accordingly.

Population: The population for this study is all the Pre-service Science Teacher Educators (PSTE) that are the implementers of Science Education programmes in Nigerian higher education institutions as well as the Pre-service Science Teachers under-going Teaching Practice.

Sampling techniques: Four higher institutions that run Science Education courses in two Geo-political zones out of the total of six Geo-political zones were randomly selected. Two of these institutions offer B.Ed, while the other two offer BSc. Ed, respectively making two types of Science Education Programmes to be compared. Three Science departments in each of the four institutions namely chemistry, physics and biology were used. This gives a total of twelve departments for the study. A total of 30 lecturers from the selected departments were used for the study. Five Pre-service Science Teachers on teaching practice were randomly selected from each of the three departments in the tertiary institutions. This gives 60 Pre-Service Science Teachers used from the four institutions of higher learning.

Instrument and Instrumentation: Two instruments namely:

- Guidelines for the Evaluation of Official documents on curriculum content of Methodology Component of Science Education Programmes and
- PSTEs' instructional strategies rating scale

RESULTS

Guidelines for the evaluation of official documents on curriculum content of methodology component of science education programmes: This was used to collect data on the specific science teaching strategies listed in curriculum content of the methodology courses of the two programmes. The presence or absence of some current science teaching strategies in the curriculum content of the methodology courses offered in the two types of programmes was determined using the conceptual analysis method of content analysis. Content analysis is used to determine the presence of certain words, concepts, themes, phrases, characters or sentences within texts or sets of texts and to quantify this presence in an objective manner. The strategies included in the analysis were gotten from researches on current science teaching strategies. These included questioning, personal projects, group projects, laboratory/experimentation methods, cooperative/discussion method, problem solving methods, field trip/excursion, guided discovery, discovery/personal inquiry method, concept mapping, instructional analogy, lecture/demonstration and lecture/expository methods. Coding was done on the basis of (-) = not listed and 1 = teaching strategy is listed in the method course.

Pre-service science teacher educators' instructional strategies rating scale: The response format is a four point descriptive rating scale of Always = 4, Sometimes = 3, rarely = 2 and never = 1.

The reliability of the items were determined by administering the instrument to 30 student teachers undergoing science education programmes in a university other than those used for the study. The validity and reliability of the instrument was determined by computation of coefficient alpha using SPSS version 13 statistical package. This gave a value of 0.83 which is an indication of the internal consistency and construct validity of the instrument.

The evaluation model: The evaluation model used for this study is the input process output model.

Input variable: The input variable is the specific science teaching strategy listed in the specific science teaching methodology courses in the institutions that prepare science teachers at the B. Ed and BSc. Ed level.

Process variable: The process variables are the instructional strategies used by the PSTE that implement the Science Education Programmes.

Product variables: This is what students learn as represented by their academic achievement expressed as scores from assessment instruments. In this study only the input and process variables are studies as the intended curriculum is what guides the PSTE and the PSSTs and the implemented curriculum is the black box of the classroom and what happens inside it. This has direct influence on what students learn and has the capacity to reflect school quality.

Research question 1: What are the specific science teaching strategies listed in the science methodology courses in the B. Ed and BSc. Ed programmes?

Table 1 shows that from the curriculum booklet that contains the course outlines of courses that students are supposed to offer, Lecture/expository and lecture/demonstration method are the teaching methods listed in the curriculum of both Science Education Programme. Personal project is also listed in the curriculum of both programmes because it is a requirement for graduation at the tertiary level. Discovery/personal inquiry method, Guided discovery, Laboratory method experimentation with lecturers' laboratory manual and Questioning methods are listed in the curriculum of B. Ed but not the BSc. Ed programme while field-trip is listed in the curriculum of BSc. Ed but not in the B.Ed.

On the whole only 53.8% of the science teaching strategies investigated in this study are listed in the science methodology course content of B. Ed and only 30.8% of them are listed in that of the BSc. Ed programme. This implies that what a lecturer of methodology course will teach or not is left at the discretion of that lecturer. This may be the reason why lecturers teach strategies that are most easy for them hence concentrating more on lecture method at the expense of more recent innovative strategies in spite of researches done in these areas showing the efficacy of these methods in enhancing students' academic achievement in science.

Research question 2: What is the pattern of PSTEs' use of instructional strategies in B. Ed and BSc. Ed science education programmes?

Results from Table 2 shows that the most prevalent instructional strategy used by the PSTEs of the B.Ed programme in the delivery of their subject is the lecture/demonstration method (89.0%). This is followed by problem solving (87.5%), laboratory/ experimentation with lecturers' instruction/ laboratory manual (86.5%), lecture/expository method (82.5%), instructional analogy (76.5%) and the questioning method (75.0%). In the BSc. Ed programme, the most common instructional strategy used by the PSTEs is the lecture expository method (88.3%). This is followed by problem solving method (87.5%), laboratory method/experimentation with lecturers' instruction/manual (86.5%), lecture/ demonstration (85.8%), discovery/ ersonal nquiry (81.8%), instructional analogy (79.3%) and personal project (75.0%). On the whole, the PSTEs of the BSc. Ed science education programme use 53.8%, while their counterparts in the B. Ed programme use 46.2% of the instructional strategies under study in their

Table 1: Presence or absence of current science teaching strategies in the science methodology courses of B. Ed and Bsc. Ed science education programmes

Specific science teaching methods listed in methodology courses	B. Ed	BSc. Ed
Lecture/expository method	1	1
Lecture/demonstration	1	1
Instructional analogy	(-)	(-)
Concept mapping	(-)	(-)
Discovery/personal inquiry method	1	(-)
Guided discovery	1	(-)
Field trip/excursion	(-)	1
Problem solving method	(-)	(-)
Cooperative learning/discussion	(-)	(-)
Laboratory method/experimentation with lecturers' laboratory manual	1	(-)
Questioning	1	(-)
Personal projects	1	1
Group projects	(-)	(-)
Total number of strategies listed	7/13	4/13
% of strategies listed in science methodology course	53.8 %	30.8

Data from Curriculum booklets of science education programmes under Study; 1 = present; 0 = absent

Table 2: PSTEs' use of instructional strategies in B. Ed and BSc. Ed science education programmes

	B. Ed			BSc. Ed		
Instructional strategies used by PSTEs	M	SD	Mean %	M	SD	Mean %
Lecture/expository method	3.30	0.75	82.5	3.53	0.50	88.3
Lecture/demonstration method	3.56	0.50	89.0	3.43	0.63	85.8
Instructional analogy	3.06	0.90	76.5	3.17	0.91	79.3
Concept mapping	2.10	0.96	52.5*	2.53	0.93	63.3*
Discovery/personal inquiry method	2.86	0.97	71.5*	3.27	0.69	81.8
Guided discovery	2.43	0.97	60.8*	2.87	0.77	71.8*
Field trip/excursion	2.40	0.93	60.0*	2.76	0.57	69.0*
Problem solving method	3.50	0.51	87.5	3.50	0.50	87.5
Cooperative learning/ discussion	2.00	0.83	50.0*	2.93	0.98	73.3*
Laboratory method/ xperimentation with lecturers' instruction/ laboratory manual	3.46	0.68	86.5	3.46	0.68	86.5
Questioning	3.00	0.53	75.0	2.80	0.92	70.0*
Personal projects	2.73	0.94	68.3*	3.00	0.53	75.0
Group projects	2.73	0.94	68.3*	2.83	0.59	70.8*
% of Instructional strategies adequately used by PSTEs			46.7			53.8

Mean %<75.0% is regarded as less than adequate usage of that strategy

classrooms. Though the PSTEs of the BSc. Ed programme use more science teaching strategies than their counterparts in the B. Ed programme, the level of usage is not adequate in either case.

Research question 3: Is there any relationship between the teaching strategies listed in the curriculum and the teaching strategies of the PSTEs?

Table 3 and 4 show that Pearson Correlation Coefficient between the specific science teaching strategies listed in the curriculum and the PSTEs' instructional strategies is -0.268 which is significant at 0.05 alpha level. This shows that there is a significant correlation between the specific science teaching strategies listed in the curriculum and the PSTEs' instructional strategies. This negative correlation is however worrisome as it indicates that the implemented curriculum is quite different from that attained by the pre-science teachers.

Research question 4: What is the composite predictive strength of the listed science teaching strategies on the PSTEs' instructional strategies?

Table 5 shows that the Pearson Product Moment correlation coefficient between the specific science teaching strategies listed in the methodology curriculum and the PSTEs' instructional strategies is 0.268. The R^2 estimated is 0.072. Further investigation using Regression ANOVA produced an F-ratio of 4.488; $p<0.05$. This means that the linear relationship between the specific science teaching strategies listed in the methodology curriculum and the PSTEs' instructional strategies is significant at 0.05 alpha level.

Research question 5: What is the relative predictive strength of the specific science teaching strategies listed in the curriculum on the PSTEs' Instructional strategies?

Table 6 shows that the degree of contribution of the specific science teaching strategies on the PSTEs' instructional strategies is significant with Beta value of -0.266 ($t = -2.118$, $p = 0.038$) implying that one standard deviation increase in the listing of the specific science teaching strategies under study in the methodology curriculum content of science education would be associated with 0.266 increase in the PSSTs' use of those instructional strategies in their classrooms.

Table 3: Pearson product moment correlation table showing the relationship between the teaching strategies listed in the curriculum and the teaching strategies of the PSTEs

Parameters	Values
N	60
Pearson R	-0.268
Significance	0.019

Table 4: Mean and standard deviation values for PSTEs' instructional strategies and science teaching strategies listed in the methodology courses of science education programmes

Strategies	Mean	SD	N
PSTEs' instructional strategies	75.73	8.98	60
Science teaching strategies listed in method curriculum	23.08	21.23	60

Table 5: Regression table showing the linear relationship between specific science teaching strategies listed in the curriculum and the PSTEs' instructional strategies

Parameters					Value
Pearson correlation (R)					0.268
R squared (R^2)					0.072
Adjusted R^2					0.056
Standard error of estimate					20.627
SOV	Sum of squares	df	Mean square	F	Significance
ANOVA					
Regression	1909.479	1	1909.476	4.488	0.038
Residual	24678.734	58	425. 495	-	-
Total	25688.213	59	-	-	-

Table 6: Linear regression table showing the contribution of the specific science teaching strategies listed in the curriculum and the PSTEs' instructional strategies

	Unstandardized coefficient		Standardized coefficient		
Model	Beta	SE	Beta	t	Significance
Constant	71.050	22.803		3.116	0.003
Science teaching strategies listed in the science education ciurriculum	- 0.634	0.299	-0.266	-2.118	0.038

DISCUSSION

The results of this study show that the curriculum content of methodology courses in both B. Ed and Bsc. Ed science education courses do not contain most of the recent innovative science teaching strategies that engage students in hands-on and minds-on activities like instructional analogy, concept maps, discovery/personal inquiry method, guided discovery, problem solving techniques, personal and group projects. Such a curriculum is therefore inadequate for the preparation of science teachers as the National policy on Education has spelt out that the objectives of science teaching include among others the cultivation of inquiring, knowing and rational mind for the conduct of a good life and democracy as well as the production of scientists for National development. Teachers prepared with such content are not likely to imbibe the culture of engaging students in practical activities. This is in line with the observation by UNESCO (1998) that traditional practices abound and remain unquestioned in Nigerian Universities. The curriculum is also very narrow and the process of expanding is very slow. It is also in line with Babalola and Jaiyeoba (2008) who pointed out that in Nigeria, higher

institutions of learning have remained unchanged in their curriculum offerings as well as Adikwu (2008) position that most of the curricula in Nigeria are outdated. The study also showed that in the tertiary institutions that prepare science teachers, the most common instructional strategies used by the PSTEs are lecture/exposition, lecture/demonstration, laboratory method/experimentation with lecturers' manual and the questioning method.

This shows that the PSTEs themselves do not use current teaching strategies for their students to copy and use when they go out to teach. This is in support of Osuafor (1999) findings that most science teachers in Nigeria are at a loss on how to effectively utilize some innovative science teaching strategies like experimentation, project method, concept mapping and field trips/excursion. It is also in line with Johnson (2004) position that most teachers are not taught using the inquiry method, so they do not have opportunity to learn science using the inquiry method neither have they conducted scientific inquiries themselves.

CONCLUSION

Results showed that the methodology component of Science Education Programmes in Nigeria is inadequate in terms of inclusion of current science-oriented teaching strategies. The PSTEs that prepare the science teachers make inadequate use of these strategies in their classrooms and there is a low, significant relationship between the science teaching strategies listed in the curricula and the PSTEs' instructional strategies. Based on the findings, recommendations were made to review the curricula.

RECOMMENDATIONS

Based on the findings the following recommendations are made: There is need for a revision of the curriculum content of the science methodology courses used in the preparation of science teachers in Nigeria in order to include some of the recent and innovative science teaching strategies if Nigeria expects her science teachers to be relevant in the global market as well as to enable them teach the younger generation using strategies that will engage them in hands-on and minds activities. It is only then that the National objectives of producing scientists for National development will be achieved.

There is need for a re-orientation of the PSTEs from their present practice of consistent use of the lecture method. As the professionals with the responsibility of producing science teachers, they have to see themselves as the mentors of the teachers they are training hence they have to use methods that they expect their students to copy and apply in their own classrooms after graduation.

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