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CONTENTS

An Intrinsic Analysis of the Nigerian Senior Secondary School Physics Curriculum

ABDALLA UBA ADAMU

Abstract

This paper analyses the intrinsic qualities of the Nigerian Senior Secondary School Physics Curriculum. The Physics curriculum was introduced in 1985 and was seen by its developers as revolutionary — although it shares the same rationale as the science curricular dinosaurs of the 1960s.

A major issue raised by the analysis concerns the extent to which the Physics curriculum presents clear specifications of intended purposes, and the methods through which it is hoped to achieve its aims.

This should provide further guidance in refining the extent to which the science curricular guidelines could be made more effective in providing satisfactory educational experiences for pupils in Physics.

Introduction

The early 1960s and 1970s saw massive science education reform activities in both developed and developing countries aimed at a more functional interpretation of science education for pupils at all levels of education. The predominant reform strategy focused attention on the nature of the science curriculum, and many science teaching projects were initiated with the aim of re- evaluating the contents of science teaching programmes and the way they are taught at both primary and secondary schools. Various accounts of these projects were given in different countries, ranging from Japan to Malawi (Imahori, 1980; Sapianchai and Chewpreccha, 1984; Lewin, 1981; Millar, 1981; Hondebrink, 1981; Ste-Marie, 1982 and Moss, 1974).

Nigeria was one of the many African countries that also embarked on the science curriculum reform process, along with the rest of the world in 1970s. One of the outcomes of the science curriculum reform process in the country was the development of the Nigerian Secondary Schools Science Project (NSSSP) by the Comparative Education Study and Adaptation Centre (CESAC) of the University of Lagos, Nigeria.

Before the development of the NSSSP materials, Nigerian secondary schools were using, as a curriculum, an examination course outline developed and examined by the West African Examination Council (WAEC). The NSSSP materials were developed in order to make science teaching and learning more revolutionary and in consistence with trends of development in science education across the world.

The NSSSP materials, in Biology, Physics and Chemistry, were used in selected trial secondary schools that have the facilities required to implement them throughout Nigeria in 1970s at senior school level (from Forms III to V). Other non-trial schools used the standard science curriculum produced by the WAEC. The NSSSP materials shared quite similar rationale found in most of the post-sputnik science curricula then characteristic of science curricular reform particularly in developing countries.

With the introduction of the National Policy on Education (Nigeria, 1984, the Nigerian government discarded the WAEC curriculum now considered obsolete to contemporary developmental needs, and introduced a new science curriculum at Senior Secondary Schools across the nation in 1985 which so closely resembled the old NSSSP materials that it was likely the latter materials were actually adopted for use throughout the Senior Secondary Schools of Nigeria as a new science curriculum. The adoption saves the trouble of developing a whole new curriculum; especially as the NSSSP materials had been on trial for over a decade at the time they were adopted on a national basis.

This paper analyses the intrinsic qualities of the Senior Secondary Science curriculum which was introduced in 1985, with specific reference to Physics, drawing attention to its features that might prove problematic in interpretation by teachers in the classroom, especially in the way intended by the curriculum developers. The choice of Physics serves to illustrate the general nature of the whole science curriculum in Nigeria (for a more detailed and general analysis of the whole science curriculum, see Adamu, 1989).

The analysis seeks to answer the following research questions:

1. What are the most significant features of the Physics curriculum in Nigeria?
2. What is the emphasis of the Physics curriculum used in the Senior Secondary Schools in relation to the aims of the curriculum?
3. What is the emphasis of the Physics curriculum across the three years of the Senior Secondary School?

Method of Study

The main analytical focus of this paper is the statement of performance objectives as contained in the Physics curriculum. The analysis was not carried out using any specific analytical scheme, although it follows the broad pattern developed by West (1974, 1975). The West scheme was developed to carry out a summative evaluation of a curriculum (the Nuffield Chemistry Project; see West, 1974) whose stated aims and suggested teaching strategies were quite similar to those stated in the Nigerian physics curriculum materials.

But because in Nigeria the term "curriculum" is used to refer only to the Physics Syllabus guide-lines, the analysis in this paper is necessarily limited by lack of any other materials associated with large scale curriculum development such as specified teachers' guides, or pupil text materials to accompany the Physics curriculum when it was introduced into the Senior Secondary Schools in September 1985.

The methodological strategy involved counting the individual performance objectives listed in the Physics curriculum and allocating each stated objective into a category of learning behaviour. This is to determine which behaviour that particular performance objective encourages in the learner, using the leading word of the stated objectives as a guide. It is expected that using this framework, at the end of the analysis a pattern of the most frequent behaviours encouraged by the curriculum developers and communicated to the pupils through teachers' interpretation of the curriculum will emerge. This should make it easier to determine if the aims of learning the subject are reflected in the individual statement of performance objectives of the subject.

The learning categories used as a framework were those developed in Bloom and Krathwohl (1956). These learning categories divide learning according to specific domains of behaviour. These are Cognitive, dealing with mental processes, Psychomotor, dealing with motor skills and Affective dealing with emotive behaviour.

General Features of the Physics Curriculum

An analysis of the general characteristics of the new Physics curriculum as contained in the syllabus guide-lines reveals its mechanism. The first significant point was in detailing its structure where its developers explained

> We have tried to organize this Physics content in a spiral form (i.e. the sections occur every year) in order to aid learning. The scope and depth of the content have been increased slightly beyond the present General Certificate of Education (GCE) ordinary level standard. (NERC 1985 p.ii).

But the most ambitious aspect of the new Physics curriculum, particularly in Nigerian classrooms lies in its suggested teaching techniques. As stated by its developers

> In order to achieve the objectives of Physics education at the Senior Secondary School level, the guided-discovery method of teaching has been recommended. So teachers are strongly encouraged to employ the student-activity based and inquiry oriented mode of teaching... Ample opportunity for laboratory activities and discussion has therefore been provided in every unity of the course. To stimulate creativity and develop skills in students, opportunity is also provided for the construction of workable devices in appropriate unit of the content (NERC 1985 p.ii).

These two main structural characteristics juxtaposed with the general aims of the Physics curriculum provided the main analytical framework for this study. The aims of Physics curriculum were listed as:

1. To provide basic literacy in Physics for functional living in the society.
2. To acquire basic concepts and principles of Physics as a preparation for further studies.
3. To acquire essential scientific skills and attitudes as a preparation for the technological application of Physics.
4. To stimulate and enhance creativity. (NERC 1985 p.ii).

Aims to Objectives

These aims are translated in the Physics curriculum through a four matrix structure in which each topic is divided into performance objectives, content, activities, and notes for the teacher.

The *performance objectives* list the expected behavioral changes a pupil should undergo as a result of learning that topic. they carry the main essence of the curriculum since they embody the aims of the entire Physics curriculum. The activities provide the medium through which the performance objectives can be attained by the students and list the experiments and projects they are expected to carry out. The contents provide the main substance of the topic, while notes for the teacher – rather sparse – provide additional information and guide-lines for the teacher about the topic.

The entire curriculum is thematically organised around two major concepts - motion and energy. Each block of concepts is arranged in such way that it appears in one form or another across the three years of the Senior Secondary School. This is in consistence with the "spiral" plan of the curriculum. This is further reflected in the breaking down of the two major concepts into five sections and topics. The sections are: Space, time and motion, Conservation Principles, Waves, Fields, and Quanta.

The main drawback to this arrangement is the treatment of all the concepts with the same currency. Moreover, no emphasis is placed on which years the more difficult concepts need to be treated. It also assumes all the concepts can be learnt equally across the years. There is hardly sufficient evidence to support this spiral structure of the concepts in the curriculum. This is more so as we still lack a reliable database about the learning strategies of the typical Nigerian student, which makes such conceptual arrangement appropriate, or feasible.

The Emphasis of the Performance Objectives

The performance objectives in Physics were analysed to show the expectations of its developers according to the three domains of learning behaviour – cognitive, psychomotor and affective. This enables judgements to be made about the relative emphasis of the Physics curriculum, and the extent to which it reflects its overall aims – which, like most educational aims, are more politically derived.

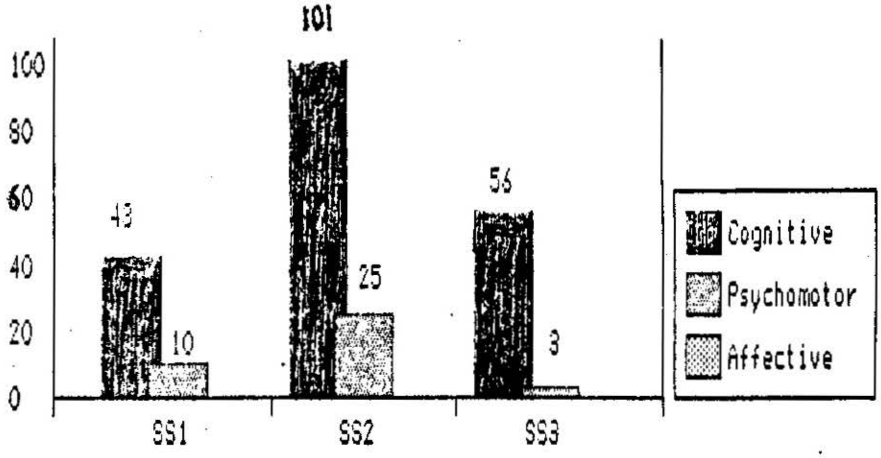

Figure I: The Distribution of Performance Objectives in the Nigerian Secondary Physics Curriculum (1985)

From Figure I most of the performance objectives seemed to be stated in the cognitive domain through out the three years of the Senior Secondary School Physics curriculum. Interestingly, for a curriculum that is "activity-oriented", there seemed to be little attention paid by its developers to writing objectives which reflect the students' active involvement with learning science expected of the psychomotor domain. This is because of the 238 performance objectives, only 38 were stated in the psychomotor domain – the rest were all cognitive level objectives. There was also no performance objective aimed at the affective domain - in terms of emotive commitment to studying Physics in form of directly observable classroom behaviour.

Though probably not intended to encouraged emphasis on acquisition of cognitive behaviours most frequently assessed in the final examination, but an overall small number of psychomotor objectives, as well as the total absence of affective objectives might be thought to encourage precisely this behaviour, which the new Nigerian science curriculum, including the Physics guide- lines sets out to eliminate, or at least, reduce.

A further feature of the curriculum is the lack of clarity, precision and consistency with which leading words were used to describe some of the performance behaviours expected from the students.

For instance, in Year I (SS1), a performance objective states "students should identify bodies charged either similarly or oppositely" (p.7) In Year 3 (SS3), another objective stated they should be able to "identify all the component parts of simple cell and accumulator" (p.40). It is clear in both these instances the "identification" requires a different emphasis in each case, yet the wording does not reflect this, and shows the inconsistency with which the word is used in the Physics curriculum. This is not an isolated case, and similar instances are encouraged throughout the curriculum.

It is therefore argued that such ambiguity could prove confusing to teachers who take the curriculum at its face value.

Another analysis, this time of the distribution of performance objectives in the cognitive domain behaviours was further carried out. This is to determine which specific intellectual skills within the range of cognitive domain behaviours the distribution of the performance objectives in the Physics curriculum encourages. The results of this analysis are summarized in Figure 2.

Thus even within the cognitive domain, there is an uneven distribution of the performance objectives; with Knowledge (92) objectives dominating the domain. Comprehension (56) and Application (52) domains interestingly, are quite close to each other. Only 3 objectives were stated in the synthesis mode of the cognitive domain. This result again reveals the inconsistency in a curriculum which aims at stimulating and enhancing the students' creativity (higher order skills) through school physics, among other aims.

A final analysis involves determining the distribution of the performance objectives across the years. This is to find out how evenly spread the objectives were, The distribution of the performance objectives across the years in Figure I reveals an interesting pattern in the level of intentions of the Physics curriculum over the three years.

The distribution of the performance objectives in Figure I indicates that SS2 has the highest number of performance objectives with a total of 126. This is more than in SS1 (53) and SS3 (59). This trend is quite significant for two reasons.

The Nigerian senior secondary school Physics curriculum is expected to build upon the Junior Secondary School Integrated Science course which the students must have followed before coming to the Senior Secondary School. From the distribution of the performance objectives in SS1 of the Senior Secondary School Physics curriculum, it is not clear whether its developers

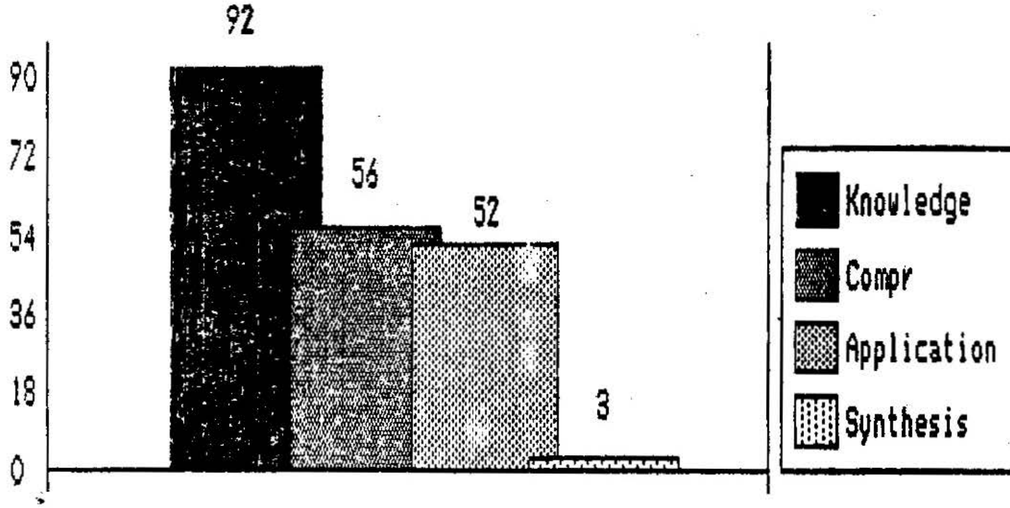

Figure II: Distribution of Cognitive Level Objectives in the Nigerian Senior Secondary Schools Physics Curriculum (1985)

feel this can be considered an effective building up of the concepts previously learnt in the last year of the Junior Secondary School's Integrated Science programme.

SS3 is significant because it is from this stage students are expected to go directly to the university and begin foundation courses as the start of a four year degree programme in the sciences, as planned in the National Policy on Education. It is not clear whether the developers of the Nigerian Physics curriculum feel the SS3 level of expectation as presented in the present Physics curriculum might be adequate preparation of students for this task. Priorities between the years in terms of the performance objectives of the Physics curriculum are not shown, with only a marginal difference between SS1 and SS3.

Thus the emphasis of the Nigerian Physics curriculum would seem to be on the acquisition of basic scientific knowledge. Other traits most commonly associated with learning science, such as the development of specific attitudes were not emphasized; while the acquisition of scientific techniques associated at school level with the development of the Synthesis and Psychomotor domains, among others, were found only to a limited extent.

These emphases would seem to be recurrent in cases where a more social rationale is given as a basis for science education programmes. For instance, Lewin (1981) carried out a similar analysis of the Malaysian Integrated Science curriculum materials whose major intentions were to reduce emphasis on the recall of factual information in favour of encouraging the development of affective, psychomotor and higher order cognitive skills. And despite this intention

> it is surprising to find that 53% of section objectives are specified at the knowledge level of the cognitive behaviour whilst only 18% of general objectives are. (Lewin 1981 p.179).

Conclusions and Implications

The analysis of the curriculum emphases of the Physics curriculum materials in Nigeria highlights the main features of the curriculum and focuses attention on its aspects which are likely to prove difficult to interpret in the way the curriculum developers intended. The absence of quite many coherently stated performance objectives, as well as the lack of precision in stating some of them must inevitably result in some degree of confusion in interpretation by those teachers who use the curriculum as the basis for their teaching. A major issue raised by the analysis therefore concerns the extent to which the physics curriculum presents clear specifications of intended purposes, and the methods through which it is hoped to achieve its aims.

This has direct consequence for teachers, who are generally expected to translate accurately into specific learning behaviours the intentions of the curriculum developer. With a curriculum that does not provide clear specifications of its intentions, it is quite possible for the wrong messages about science to be subsumed by pupils.

Interestingly, while Nigeria is struggling to implement a post- sputnik science curriculum, the emerging pattern in the international science curriculum development in the late 1980s, is a departure from the package deal approach that characterised the post-sputnik science curricular reforms of the 1960s. This was in part brought about by rapid social and economic changes which brought with them critical re-appraisal of the post-sputnik science programmes. In the United States, consistent criticism of the programmes in the early 1970s led to evaluation studies as reported by Stake and Easly (1978), and Kahl and Harms (1981). In Canada the re-appraisal process was initiated by The Science Council of Canada leading to a three volume analysis of science education in Canadian schools which paints a rather depressing future for the 1990s (Orpwood and Souque 1985, and Ste-Marie 1982). In England, the Association for Science Education lent its voice to the growing crisis of confidence in the post-sputnik science curricula with a series of rather radical curricular alternative with strong emphasis on the philosophy and social dimensions of learning science (ASE, 1979).

And earlier on, developing countries, especially those in Asia which had adopted or adapted overseas (American or British) curricula were, by 1969,

> experiencing considerable difficulties in their use, as was reported by delegate after delegate at the joint UNICEF-UNESCO regional workshop on planning for science teaching improvement in Asian schools, held in Bangkok, Thailand in 1969. (Maddock 1981 p.5).

In Africa, Yoloye and Bajah (1980) also reported similar problems with the implementation of a continental Science Education Programme for Africa (SEPA) which was a post-sputnik attempt at revolutionising the teaching and learning of science, especially in African primary schools.

It is clear therefore that a second wave will soon engulf the science education community bringing with it further messages about the role of science curriculum in human affairs in the 1990s. Developing countries such as Nigeria need to evaluate the impact of the emerging trend, and determine a science education programme consistent with their social, political and economic realities.

In the meantime, to make further judgments about the extent to which the school realities of the newer science curricula (referring to, in most developing countries, the post-sputnik programmes) matches their structural rhetoric, more investigations need to be carried out to determine the way the curricula are interpreted by teachers in the classrooms, and the role of extraneous factors, such as examinations, on their interpretation of the curricula. This should provide further guidance in refining the extent to which the science curricula could be made more effective in providing satisfactory educational experiences for pupils in Physics.

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Author

Dr. Abdalla Uba Adamu, Department of Education, Bayero University, Kano. Specialisation: Science Education.