
The Study of Curriculum Change in Botswana with Special Reference to Primary Science: an historical perspective

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ABSTRACT This paper traces historical events in the development of primary science in Botswana. It identifies changes that have taken place from 1969 to 1989. Prior to 1969, the word *science* in primary schools was non-existent. Primary pupils were taught nature study which emphasised hygiene and plants. The revised 1982 primary science curriculum coincided with the period of rapid industrial developments in Botswana. The purpose of including physical science concepts in the primary science curriculum was to prepare the nation for industrialisation. The purpose of including environmental concepts in the primary science curriculum was to raise the environmental awareness of the nation.

Introduction

Curriculum change is done with the hope of improving the quality and the efficiency of education so that it is cost effective and relevant. The 1960s in Botswana witnessed on a large scale changes in primary curricula. These changes were partly the result of curriculum developments that took place in developed countries especially Britain. For example, the current Botswana primary science curriculum was adopted from the Scottish Integrated Science Scheme. The primary science panel in Botswana adopted the philosophy of integrated science even though it was for secondary schools. The philosophy of integrated science was 'teach science by investigation' (Leburu & Rosser, 1980). The primary science panel advocated activity oriented teaching because it could promote understanding. The intent of this paper is not to examine the

effects of primary science curriculum change, but rather to examine the stages that are inherent in curriculum innovation in the context of Botswana, forces behind the changes and models of curriculum development used in Botswana schools and the status of primary science in Botswana.

History of Primary Science in Botswana

Prior to 1968, science in Botswana primary schools was referred to as nature study. In 1969 nature study was changed to science. Nature study was found inadequate to prepare the nation for industrial developments because it emphasised the study of plants and hygiene but lacked a great deal of physical science concepts. In the teaching of nature study, emphasis was placed on some process skills such as drawing, labelling, observation, experimentation and recording but not other process skills which could only be practised if physical science concepts were introduced (Leburu & Rosser, 1980).

The investigatory method of teaching advocated by the panel was believed to be achieved by answering questions such as 'How' and 'Why' which form part of physical science teaching (Leburu & Rosser, 1980). The teaching of nature study was considered inadequate because lecturing dominated the teaching-learning context in which children were passive participants. The teacher was the most active participant and dispenser of knowledge and this was in conflict with the investigatory method which called for children's active participation in the learning process. The investigatory method was believed to enhance and to promote children's understanding of scientific concepts.

The philosophy of discovery teaching as stated by the primary science panel was that: every child should actively participate in the learning process; and that teachers should use concrete materials to ensure that pupils actually see, touch, smell and taste real objects.

The primary science panel came up with the following objectives for primary science curriculum:

- (1) To make pupils aware of and interested in the natural world surrounding them.
- (2) To develop pupils' power of observation through activities such as looking at plants, animals and non-living things and making records of observations verbally, through drawing diagrams, and in writing.
- (3) To develop pupils' ability to express themselves clearly in a scientific manner using basic scientific terms.
- (4) To encourage and assist pupils where necessary to find out things for themselves by experimentation and observation.
- (5) To provide knowledge which will enable pupils to understand those science concepts that they are likely to meet in everyday life.
- (6) To develop pupils' skills in using scientific apparatus such as rulers and thermometers.

- (7) To develop pupils' awareness of how science is involved in other subjects in school and also in everyday life.
- (8) To develop pupils' awareness of the contribution of science to the social and economic life of the community. (Leburu & Rosser, 1980, pp. 84-85)

The development of primary science curriculum is the responsibility of National Primary Science Panel. The duties of the primary science panel include:

- (1) Revision of science curriculum.
- (2) Writing primary science teachers' guide which include activities to be done by pupils.
- (3) Writing pupils' science text books.
- (4) Setting national science examination for Standard 7 pupils.

Although the panel came up with the above objectives, primary science was still taught poorly due to lack of qualified teachers, inadequate equipment and lack of teaching materials. However, as the number of qualified primary school teachers increased, the teaching of primary science improved substantially (Leburu & Rosser, 1980). In 1982, a new science panel was formed, and this panel was composed of qualified Botswana science educators who suggested that the 1969 science curriculum be revised. At the same time the Department of Curriculum Development and Evaluation was established an education officer designated responsible for primary science. The 1982 primary science panel members and the education officer responsible for primary science added one further objective to the 1969 objectives: (9) To express a respect for all life and desire to maintain the quality of their surroundings (Republic of Botswana, Department of Curriculum Development and Evaluation, 1982, pp. 16-17).

One of the most important aspect of the 1982 primary science curriculum is this objective that calls for the maintenance of a quality environment. This objective is crucial because every child should be taught ways of preserving and maintaining quality environments.

The current primary science panel was established in 1989. It is composed of primary school teachers, training college lecturers and the senior science education officer from the Department of Curriculum Development and Evaluation. The current primary science curriculum is based on the government's policy of nine years of basic education for all.

The 1989 aims of primary science are that pupils will:

- (1) Develop skills of finding out information for themselves using science process skills which underlie the continuing development of scientific knowledge.
- (2) Gather knowledge which will enable them to understand science concepts likely to be met in everyday life.
- (3) Express awareness of, and interest in, the natural world surrounding them.
- (4) Express a respect for all life and a desire to maintain the quality of their surroundings.

- (5) Express awareness of science contribution to the social and economic life of the community.
- (6) Develop positive attitudes towards science. (Republic of Botswana, Standard 1-9 Science Syllabus, Department of Curriculum Development and Evaluation, 1989)

An important aspect of the 1989 primary science curriculum is the inclusion of the development of positive attitudes towards science. Teachers' effectiveness and efficiency in teaching primary science are governed by beliefs, intentions, behaviours, attitudes and possession of subject matter. Teachers who possess positive attitudes towards a subject tend to promote the same attitudes in students.

It has been found that students who possess positive attitudes towards a particular subject tend to learn it with understanding (Iozzi, 1989). Primary science panel members have found it necessary to include an aim that deals with the affective domain in primary science curriculum because they recognise the role that positive attitudes play in promoting the learning of science. It is the duty of every teacher to inculcate into students positive attitudes towards science.

Forces that Initiated Curriculum Changes

(1) Government Policy of Having Trained Personnel for a Technological World

The government of Botswana wanted technically skilled manpower for industrialization (Kahn, 1986). The policy was that primary pupils should have access to science education. In 1966, a primary science panel was established (Leburu & Rosser, 1980). The panel was delegated the task of designing a science curriculum for primary schools so as to establish a foundation for the training of skilled manpower. The issue here is that the government wanted to have its local skilled technicians to promote industrialization in Botswana.

The 1966 primary science panel found nature study obsolete and unsuitable for a technological world. The primary panel was composed of members who were Botswana educators and the inspectorate who were mostly British. These inspectors came from Britain, a developed country which was technologically more advanced than Botswana. The inspectors found it necessary to include science in the primary school curriculum as a means to prepare students for a technological world.

(2) Professional Advancement and Training of Teachers

The teaching of primary science in Botswana improved substantially due to:

- (a) enrolment of student teachers in primary teacher training colleges who had followed the Cambridge course;
- (b) increased numbers of student teachers who had completed a three year Junior Certificate course and had enrolled in primary teacher training colleges;
- (c) enrolment of enthusiastic and interested Standard 7 student teachers;
- (d) the fact that science is examinable in the Primary School Leaving Examination;
- (e) the launching of science workshop for serving teachers.

As the number of qualified teachers increased in Botswana's primary schools, changes in the primary science curriculum were introduced. These changes were initiated by teachers who were academically and professionally qualified to introduce changes. Qualified, competent teachers have been reported to have introduced new innovations (Chiepe, 1981).

(3) The Political System

The Botswana government, especially the ruling party, was committed to technological and industrial development. As a result they supported, financially and morally, innovations in science education. They supported the training of human capital for scientific and technological developments. A society which is faced by industrial developments such as Botswana is susceptible to change. It must be scientifically literate so as to cope with industrialization. The government of Botswana argues that to meet the demand of industrialization, a society must have trained personnel. The demand for scientific and technological development requires a society with an understanding and a knowledge of scientific concepts. A knowledge of science is a prerequisite to the training of human power in fields that will facilitate industrialization. As a result, nature study was found inadequate for industrial developments and so was replaced by science.

(4) The Education System

In Botswana, the education system is controlled by the government. All curricula are controlled from the centre, i.e. by the Ministry of Education's Department of Curriculum Development and Evaluation. Botswana is an examination oriented country and when curricula changes were introduced for example at the primary school level, no individuals opposed them. The effectiveness of a centralized system is very clear in Botswana.

(5) Textbooks

Members of the secondary science panel were impressed by a process oriented approach to the teaching of science. Textbooks and students'

worksheets were taken from the Scottish science curriculum. The pupils' worksheets were written in such a way that process skills were practised. Members of the secondary science panel thought that process skills practised in secondary pupils' worksheets could easily be practised by primary pupils as well. Through the influence of secondary science panel, primary science panel members adopted the Scottish science curriculum. Textbooks were available and these had major influence on curriculum changes. They effectively determined the curriculum. The current Botswana primary science textbooks are process oriented because they are based on the Scottish Integrated Science textbooks.

(6) Professional Organizations

Professional organizations such as the Botswana Science Association (BOTSA) had a major influence on science curricula in Botswana. Some members of the Botswana Science Association were also members of primary science panel who suggested that the old primary science curriculum be revised. They noticed that primary science curriculum consisted of biological and earth science concepts and therefore needed a change to include physical science concepts. The primary science curriculum was revised thrice in 1969, 1982 and 1989. These changes are credited to the initiatives of primary science panel members.

(7) Theories of Learning

The Botswana primary science curriculum reveals that it has been influenced by behaviourist and cognitivist learning theorists because the emphasis is on the attainment of objectives, efficiency, knowledge and intellectual development. A behaviourist who may have influenced Botswana primary science curriculum is Gagné. Gagné has consistently stated that learning must move from the simplest activities to more complex ones.

Primary science in Botswana may also have been influenced by learning cognitivist theorists such as Piaget and Bruner. Piaget believes that children should be given the chance or opportunity to interact with the physical environment, and to manipulate objects.

Problem solving is another aspect of Botswana science curriculum. A learning theorist who may have influenced the inclusion of problem solving in the primary science curriculum is Bruner. *Learning by doing* is what Bruner advocates in the teaching of primary science. Our current primary science curriculum talks of investigatory method, where students do activities which help them to gather, and to organize information in a meaningful way.

The Botswana primary science curriculum stipulates that children should learn scientific concepts related to what they do at home and what they are familiar with so that learning becomes meaningful and relevant. An

advocate of meaningful learning is Ausubel. Both Piaget and Ausubel have consistently stated that knowledge is socially determined (McClelland, 1985). That is, children learn meaningfully if what is taught is related to their existing ideas.

Phases Inherent in Curriculum Innovation

(1) Initial Stages

The first stage of curriculum innovation is what might be referred to as 'the decision making stage or the initial phase' (Harding et al, 1976). At the initial stage or phase, Botswana education officers in charge of primary science propose that a change be introduced. They might have got ideas from curriculum projects of other countries which appeared more appropriate and relevant to Botswana. The other source of information might be that education officers attended science workshops in some countries and thought that ideas presented at the workshops were good and applicable to Botswana. The training of education officers in developed countries had also contributed to changing or introducing a new science curriculum. If education officers in charge of primary science are given the go ahead by their superiors, they then consult with the panel members about changes to be introduced in the primary science curriculum. Panel members can raise their opinions about the changes. Primary science panel members and education officers then agree on what is to be included in the curriculum and what is to be excluded from it.

(2) Production Stage

In this stage, there is production of teaching materials, such as textbooks, teachers' guides and worksheets. Within the panel, a committee which oversees the production of materials is formed. For example, some members of the primary science panel produced primary science textbooks and teachers' guides for grades 1-6. These are currently being used in Botswana primary schools. The members put together materials first, check typing errors, sentence omission and other mistakes. Within the panel, some members might choose to try the materials in their schools, hence the trial stage.

(3) Trial Stage

Some members of the primary science panel in Botswana try new materials in their schools. The intent of the trial stage is to get information from trial schools and use it to correct or improve the materials. The trial schools will point out things that need to be changed or modified. The trial stage is very

important at least in the view of the panel members because it is at this stage that they get feedback which will help them improve materials.

(4) Diffusion/Dissemination Stage

It is at this stage that schools are informed about a new curriculum and new materials. Education officers in Botswana, even those who are not members of the panel, defend the new primary science curriculum and point out its importance to teachers. All teacher are informed that the new primary science curriculum will be adopted by all schools in the country.

(5) Adoption Stage

This is the stage in which the Ministry of Education officials in Botswana will send a directive to schools stating that a new primary science curriculum will be adopted and that it will be examined publicly in a given year. It is at this stage that the new primary science curriculum is an official document. All teachers are expected to implement it at classroom level.

(6) Implementation Stage

This is the critical stage of any curriculum innovation because it is here that teachers have control over the curriculum. The success of the implementation stage depends entirely upon teachers who can either sabotage it or implement it. Although teachers cannot block or impede the implementation of any new curriculum, what goes on in the classroom is directly under their control and they may teach some topics or not teach them at all. The Ministry of Education officials in Botswana may find out if the new curriculum is being taught properly by examining pupils, especially those who are doing Standard 7.

(7) Evaluation Stage

Evaluation in this context refers to the extent to which grade seven pupils perform in a science achievement examined. Evaluation is a complex process, but in the context of Botswana it is narrowed down to performance in science examinations whereby schools labelled 'good' have a high percentage of their students having done well in their final examinations. The examination results are used as feedback to the curriculum development officer who writes a report pointing the success or failure of the new curriculum. It should be realized that students' performance in an examination may be low due to examination questions lacking content validity. The validity and reliability of examination questions should be established during the evaluation stage. This is not done in Botswana.

Models of Curriculum Development

Within the context of curriculum development, primary science panel members follow a philosophical stance or a model. Traditionally, the primary school curriculum in Botswana is subject-based which reflects an acceptance of the classical model or the behaviourist model of curriculum development (Lawton, 1979). In the classical model, education is seen as an induction of the learner into the established discipline forms of knowledge, it may hence be thought of as a preparation for adult life.

In the 1960s there emerged a number of people who followed a philosophical stance called progressivism or romanticism or process model. The progressivist or romantic movement in education advocates child-centredness (Lawton, 1979). One of the features of child-centredness is that it stresses the unity of knowledge and therefore seeks to counteract the compartmentalization of knowledge. One of the reasons for this is that children/pupils see problems not in a fragmented form (fragmented by subject boundaries) but view them in a holistic way. Integrated Science came into being because of the progressivist movement.

Characteristics of the Botswana Model

The primary science panel strikes a balance between progressivist and behaviourist philosophical stances. Following Kelly (1982), the objectives model is used for logical reasons (for an activity to be rational, it should be directed towards some clear goals or purpose); scientific reasons (if education is to be respected, then it must be based on precision, accuracy and efficiency); politico-economic reason (objectives help the public to evaluate a curriculum project effectively and to ensure that the public's money is not wasted); and educational reasons (objectives are crucial for evaluation which in turn is crucial for effective teaching).

Botswana educators also follow an integration of the objective-based and progressivist models of curriculum development. Following Lawton (1979), the progressivist aspect of the Botswana curriculum revolves around methods that are: child centred (where pupils actually engage fully in learning activities); based on teacher creativity (teachers can design other activities that are more effective in enhancing and in promoting an understanding of scientific concepts) sensitive to pupils' everyday experience and which encourages discovery teaching.

The Present Status of Primary Science in Botswana

Although attempts are being made to teach primary science in an investigatory or child-centred way, primary science in Botswana is still being taught in the lecture form (i.e. teacher-centred) where pupils copy notes from the chalkboard into their note books. This arises from a scarcity of good equipment and activity-oriented textbooks, and teachers who are

ill-prepared in their initial training for science teaching. Finally, teacher supervision is difficult because there are few education officers for a large number of schools.

Conclusion

This paper has indicated that major primary science curricula changes occurred in Botswana thrice: in 1969, 1982 and 1989. The paper has also indicated that curriculum developers in Botswana still follow one major philosophical model of curriculum development namely the objective-based model. This model is based on clear statements of objectives/aims. Botswana educators argue that objectives provide the criteria for judging the effectiveness of the system. The model concerns itself with efficiency and effectiveness and value for money, and management.

In Botswana, the trend is now towards the use of both the objective-based model and the progressivist model. Botswana educators think that both models would enhance understanding. The integration of the two models of curriculum development enables teachers to use process skills in teaching primary science. The use of process skills promote understanding.

Very few teachers are involved in all stages of curriculum development. Despite that, teacher involvement is very crucial because it is they who are the true implementers of a new curriculum. Attitude change is now stressed in the current primary science curriculum. The purpose of including attitudes in the science curriculum is to help pupils gain more scientific knowledge. Environmental concepts have been included in the primary science curriculum to help pupils to respect the environment.

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