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ELEMENTS OF CONTEMPORARY INTEGRATED SCIENCE CURRICULUM: IMPACTS ON SCIENCE EDUCATION

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ABSTRACT

This paper acknowledged the vital roles played by integration of ideas and established the progress brought about when science is taught as a unified whole through knowledge integration which birthed integrated science as a subject in Nigerian school curriculum. The efforts of interest groups at regional, national and international level to overhaul African school curriculum after the colonial era were highlighted. The six (6) elements of integrated science as a subject were discussed and the three (3) elements of integrated Science curriculum were outlined. The relationship between the various elements is summarized diagrammatically. The effects of integrated science curriculum on science education are presented in a tabular form. The findings of the research are that integrated science curriculum content is dense as it is over ï loaded with concepts as a result of knowledge integration; hence majority of the students avoid taking or offering science subjects. Sequel to this, it was recommended that integrated science curriculum be reviewed so as to remove overlapping or repeated concepts. So also, more emphasis should be laid on practical applications of concepts while less emphasis is laid on rote memorization.

KEY WORDS: Contemporary, Curriculum, Elements, Integrated, Science

INTRODUCTION

Human survival depends on knowledge through the exploration of the environment. Science provides knowledge while technology provides ways of using this knowledge and our value concepts guide what we ought to do with both science and technology (Hurd, 1975). Discoveries in nature are made easier through integration of ideas, thoughts and concepts. To this end, science teaching in the modern world ought to be interdisciplinary, unified, society based and aspire above all to achieve scientific literacy (Arokoyu and Dike, 2009). These are essentially the characteristics, components and elements of integrated science in general. Basically, there are two components of science which characterize its nature; these are processes and products of science. Scientific processes are activities engaged in by scientists some of which are observation, investigation, gathering of data, classification and tabulation. Products of science are the dividends of scientific activities these include laws, principles, hypotheses and theories.

Integrated science program was initiated in 1969 by UNESCO to assist member countries in promoting scientific literacy in a unified way both at the primary and secondary school levels. This brought a great awareness in science curriculum improvement in Nigeria. With independence gained in 1960, a critical look at what was studied as science in schools revealed a lot of discrepancies and irrelevances as most of the ideas and examples were alien to Nigerians. A change or general over hauling of the curriculum with more emphasis on science curriculum was needful if the nation really desires to develop scientifically.

Meaning of Integrated Science

UNESCO ï UNICEF (1991) defined integrated science as an approach to the

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teaching/learning of science in which concepts and principles are presented so as to express the fundamental unity of scientific thoughts and avoid premature and undue stress on the distinctions between the various scientific fields. In his contribution to the definition of integrated science, Willard (1995) describes it as a program which offers students experiences which help them to develop an operational understanding of the structure of science that should enrich their lives and make them more responsible citizens in the society. The concept of integration in school science subjects lays emphasis on both concept/theme and teaching methods. D'Arbon (2002) noted that:

Integration; when applied to science courses, means that the course is devised and presented in such a way that students gain concept of the fundamental unity of science; the commonality of approach to problems of scientific nature; and are helped to gain an understanding of the role and function of science in everyday life and the world in which they live.

Brown (2007) describes integrated science under four broad characteristic meanings

I. The unity of all knowledgeé that integrated science has a holistic view of knowledge as essentially one and undivided;
II. The conceptual unity of the sciencesé that various conceptual units that make up the framework are identified;
III. A unified process of scientific enquiryé This characteristic places emphasis on the methodological distinctions and similarities among the sciences;
IV. An interdisciplinary studyé that the discipline is a collaborative venture between subjects and viewing of topic or theme from logically different viewpoints with the learner left to synthesize in any way he chooses.

Origin of Integrated Science

The introduction of integrated science as a subject into the science curriculum emanated from WAEC 1968 request to STAN for more functional science content. This was as a result of dissatisfaction in the existing curricula by many African countries that just had their independence. About the same time, the African Primary Science Program (A.P.S.P) introduced its unique way of teaching science which involves inquiry/discovery activities whereby learners find out things for themselves while the teacher acts as a supervisor and not purveyor of knowledge. The APSP was an integrated and environmental based science specifically designed for Africa. Nigeria was one of the 14 English ï speaking (Anglophone) African countries that adopted the program. STAN having recognized the importance of integration insisted that any science program drawn for WAEC must be based on a nationally uniform science background of learners. Sequel to this new dawn or awakening, African leaders started meeting at seminars, conferences and workshops to discuss and plan for the new change. Such conferences included the following:

1. The Addis ï Ababa congress under the auspices of UNESCO in 1960. This brought together ministers of education of African countries.
2. e Rehovoth conference on science of July 1960 held in Israel where it was agreed that the potential application of modern curriculum development techniques should be explored.
3. The African summer study conference of 1961 in Dedham Massachusetts, U.S.A and
4. The Rome conference, 1964. This was a follow ï up of the Dedham conference and it is also referred to as Edincott House Conference.

As a result of these conferences, several new science programs were started at regional, national and institutional levels. Most of the programs were geared towards the primary school and junior secondary school levels. This is premised on the fact that if the future generation of Nigerians were to contribute significantly to the scientific and technological progress of the country, according to Arokoyu (2003) a sound base for science education is not negotiable; hence the emergence of integrated science as a subject at junior secondary school level in order to catch them young in the area of science.

Nature of Integrated Science Curriculum

The integrated science curriculum is concerned with the processes and products by which scientific knowledge is constructed and validated. Science as a process or way of knowing consists of local methods of approach and the right attitudes of mind which guide inquiry into truth about natural phenomena. Scientific process can be approached via observation, data

collection, experimentation, formulating hypothesis, stating the problem, making inferences et cetera; while scientific products are hypotheses, theories, principles and laws. These products subsequently help to discover facts about the universe. The different facets of the nature of integrated science (process and product) are highlighted below.

- Scientific attitude: searching for truth; science is based on evidence and empirical standards; and it also encourages innovation and skepticism.
- Scientific thinking: scientific knowledge is built on creative thinking; the application of deductive and inductive logic leads to the emergence of new scientific theories, principles, hypothesis and laws which are then tested empirically. Scientific knowledge though durable also has a tentative character.
- Scientific Practice: Precise experiments, design and proper instrumentation; prudent handling of quantitative and qualitative data; honest reporting.
- Scientific Community: community with a collective wisdom, encouraging free exchange and open ï minded discussions and debates.

Rationale for Integrated Science Curriculum

Integrated science was designed based on the observation that the universe is a unified whole therefore there must be a holistic approach to its study. Furthermore, science is not just a body of knowledge or facts, but it is a process of thought and action through which we understand natural phenomena. No wonder Rutherford and Gardner (1971) rightly said:

"To some degree, the concept of integrated science teaching is based on the parallel assumptions that the universe has an inherent unity and that science as an attempt to provide an understanding of the natural world has a unity of purpose, content and process that is far more significant than the differences in language or focus between individual sciences"

The integrated science curriculum provides students the broad and sound knowledge base to meet the challenges of living in a technologically advancing society. The curriculum adopts an interdisciplinary systematic approach through inquiry, students will develop scientific knowledge and skills that will help them evaluate the impact of scientific and technological developments. Furthermore, integrated science curriculum empowers students to be inquisitive, reflective and critical thinkers by equipping them with a variety of ways of looking at the world.

Aims and Objectives of Integrated Science Curriculum

The overall aim of the integrated science curriculum is to provide learning experiences that will enable students to develop scientific literacy. So that students can participate actively in our rapidly changing knowledge ï based society, prepare for further studies or careers in fields where the knowledge of science will be useful. However, the broad aims of integrated science curriculum are to enable students to:

- Develop interest in and maintain a sense of wonder and curiosity about the natural and technological world;
- Acquire a broad and general understanding of key science ideas and explanatory framework of science and appreciate how the ideas were developed and why they are valued;
- Develop skills for making scientific inquiries;
- Develop the ability to think scientifically, critically and creatively and to solve problems individually or collaboratively in science related contexts;
- Use the language of science to communicate ideas and views on science ï related issues;
- Make informed decisions and judgments about science related issues;
- Be aware of the social, ethnical, economic, environmental and technological implications of science and develop an attitude of responsible citizenship; and
- Develop conceptual tools for thinking and making sense of the world.

Elements of contemporary Integrated Science and Integrated Science Curriculum

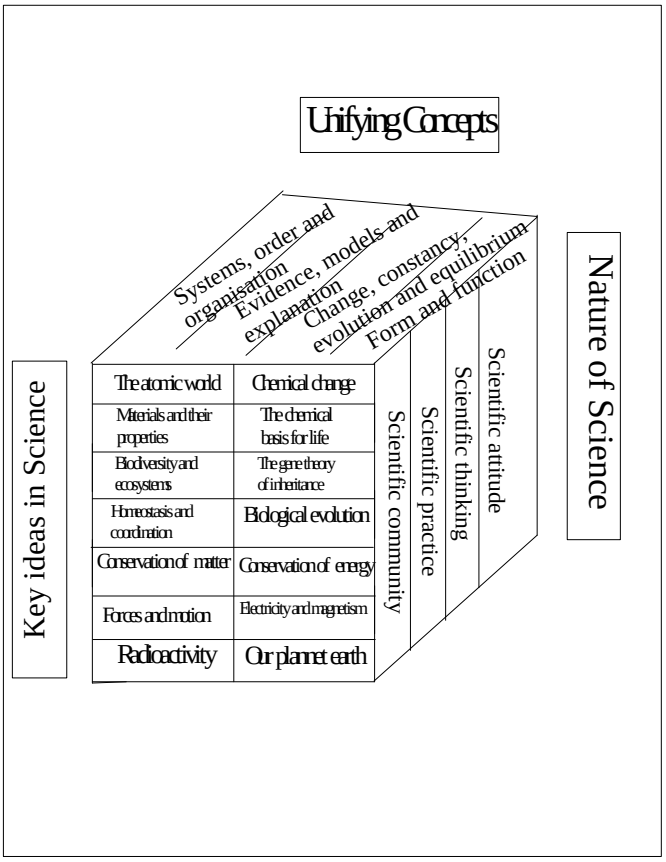
The integrated science curriculum follows the general direction for the development of the school science curriculum set out in the "Science Education Key Learning Area Curriculum Guide (2002)" which puts forward a framework for arranging major learning elements in science into six strands namely

1. Scientific investigation
2. Life and Living
3. The material world
4. Energy and change
5. The Earth and Beyond
6. Science, Technology, Society and Environment (STSE).

- Scientific investigation: It is a way of inquiry into nature by applying scientific processes which are: stating the problem, formulating hypothesis, designing experiment, observation, collecting data and drawing conclusions or making inferences.
- Life and Living: It comprises of the study of life as in biology which covers both plants and animals as living things. It enables one to understand the principles of energy and change, heredity and related concepts, functions of cells and organisms, biological evolution and the diversity of life, relationships among organisms and their physical environment.
- The material world: Consists of physical and chemical sciences which enable one to understand the structure and properties of matter, sources and properties of energy, forces of motion.
- Energy and change: this has to do with energy sources, utilization, conversion and conservation. Energy change posits that matter can neither be created nor destroyed in the course of a chemical reaction; instead energy can be converted from one form to another.
- The Earth and Beyond: Comprises of geography, geology and physics. It enables one to understand atmospheric processes and the water cycle.
- Science, Technology, Society and Environment (STSE): It is all encompassing. It integrates all facets of science in terms of process and product.

Overtly, integrated science curriculum in adopting a thematic approach based on context of daily relevance, expected that students will develop understanding of

I. The key ideas in science.
II. The nature of science and
III. The unifying concepts in science. The diagram below gives a summary of the relationship between elements of integrated science as a subject and elements of integrated science curriculum.



Framework of integrated science programme (Source: CDC & HEAA, 2007)

Impact of Integrated Science Curriculum on Science Education

The introduction of integrated science as a subject in junior secondary school curriculum has lent a lot of strength/support to the foundation of teaching and learning science. Integrated science offers students the benefit of learning science concepts from different science disciplines in contexts which are expected to have enduring relevance to them in future. Through systematic inquiry, students develop scientific knowledge and skills which help them to evaluate the impact of scientific and technological developments. Succinctly, the various ways by which integrated science curriculum has affected or impacted on science education are outlined into areas of less emphasis and more emphasis as shown below.

Table 1: Areas of less emphasis and more emphasis in integrated science teaching

Areas of less emphasis in integrated science teaching	Areas of more Emphasis in integrated science teaching
Memorization of terms	Application of terms
Learning concepts as abstract	Learning concepts as concrete
Talk ï chalk lecture method	Active practical and experimental method
Recall or cognitive testing	Discussion, affective and psychomotor testing
Learning science mainly from text books	Learning through investigation and guided inquiry and discovery
Close ï ended evaluation	Open ï ended evaluation
Individuals completing assignments	Teamwork, cooperative and collaborative learning
Head ï on learning	Hands ï on experiences
Too many topics	Fewer and fundamental topics
Teacher ï centeredness	Child ï centeredness

Source: Researcherôs field work 2010.

RECOMMENDATIONS

Based on table 1 above, it is recommended that integrated science teachers should pay great attention to the various areas of less or more emphasis in its teaching and learning. So also, there should be periodic review of integrated science curriculum in order to meet with the ever changing needs of the society.

CONCLUSION

Integrated science curriculum seeks to achieve a better balance between the traditional didactic science and the modern humanistic science that prepares students for richer understanding and use of science in everyday life. It also provides students with a wider range of scientific ideas and considers them in greater depth. Through its study, students are given many opportunities to reflect on issues and controversies in matters involving science and technology; thus becoming better informed and more sophisticated consumers of science related information.

Worthy of note is the fact that while scientific knowledge exposure is good for national development, it adds to the pressure on the science curriculum. There is a reluctance to replace the old with the new; instead, there is a tendency to simply add the new science ideas to the traditional ones (Goodrum, Hackling and Rennie, 2001). Sequel to this, the tendency is for integrated science curriculum to be over ï crowded. This will in turn result in non ï coverage of its syllabus.

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