

# **BUILDING A SCIENCE - ORIENTED SOCIETY: NEW CHALLENGES FOR SCIENCE EDUCATION IN NIGERIA**

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## **ABSTRACT**

The daunting challenge of making Nigeria a land of full opportunities, able to generate a great and dynamic economy is a call to build a new Nigeria that is knowledge driven and science oriented. The challenge is that a new orientation in science teaching and learning has become imperative. The constructivist view, which allows students to perform science as they construct meaning and acquire understanding, and also participate in real-life problem-solving activities, is advocated in our schools. This is because knowledge construction is capable of inducing higher level of student achievement in the sciences, and will therefore help to build a science-oriented, authentic society.

**KEYWORD:** Constructivism, knowledge construction, authentic instruction and stimulating experiences.

## **INTRODUCTION**

The need to make science education more relevant to the needs of the society has become a major concern worldwide among educators. This is because, more than ever before, the need for science-oriented society has become not only imperative but very urgent. In this 21<sup>st</sup> century, most developing nations, like Nigeria, are concerned with how to foster national and technological development more rapidly so as to bridge the gap between her and the developed countries. The National Policy on Education recognised education as "a dynamic instrument of change" (Federal Republic of Nigeria, FRN, 1998). The policy formulated four basic national educational aims and objectives, which are geared towards building a desirable society, Viz,

- (1) The inculcation of national consciousness and national unity;
- (2) The inculcation of the right-type of values and attitudes for the survival of the individual and the Nigerian society;
- (3) The training of the mind in the understanding of the world around and
- (4) The acquisition of appropriate skills, abilities and competences both mental and physical as equipment for the individual to live in and contribute to the development of the society (P. 8).

Thus, in line with these aims and objectives, the World Bank (2002) in a published report on the dynamics of knowledge economies and on science and technology development argued that education has the potential to enhance economic growth and reduce poverty. The document submits that:

- (a) Social and economic progress is achieved principally through the advancement and application of knowledge.
- (b) ... education is necessary for the effective creation, dissemination, and application of knowledge and for

- (c) building technical and professional capacity. Developing and transition countries are at risk of being further marginalized in a highly competitive world economy because their education systems are not adequately prepared to capitalize on the creation and use of knowledge.
- (d) The state has responsibility to put in place an enabling framework that encourages ... education institutions to be more innovative and more responsive to the needs of a globally competitive knowledge economy and to the changing labour market requirements for advanced human capital. (P. XIX)

Thus, from the above, education has become an instrument per excellence for achieving the onerous task of rapid national and technological development.

## **NATIONAL CHALLENGES**

Recent events in Nigeria seem to question the relevance of education to national development. Instead of contributing to the solution of national problems we find a situation in which the students are themselves a bundle of worries and problems that require urgent national solutions. There are perennial problems of agitations, unrests, conflicts and cultism of sorts amongst students at all levels of education. This prompted Majasan (1971) to wonder whether the time spent in our schools, colleges and universities in trying to get the rising generations educated is not really wasted. Majasan went on to give reasons for this state of worry when he wrote:

Individuals and groups from these institutions are so involved in anti-social acts and uncompromising attitudes that many responsible citizens are genuinely concerned about the irrelevance of institutional education to life and good living (P. 12).

Thus, Nigeria is a country faced with the crises of confidence in the operation of her educational enterprise. While there are serious worries with regards to the perceived irrelevance of institutional education among professional educators as expressed by Majasan, the National Policy on Education is reposing on institutional education the responsibility of life long education of the citizens. For example, the National policy on education is "Government's way of achieving that part of its national objectives that can be achieved using education as a tool" (FRN, 1998, P.7). Thus, the policy stated explicitly that Nigeria's philosophy of education "is based on the integration of the individual into a sound and effective citizen" (P.7). The purpose of education in this direction is making children exposed to institutional education in Nigeria responsible citizens.

For these to be achieved, the national policy laid emphasis on quality instruction at all levels of our education geared towards inculcating among others the following values:

- (a) respect for the worth and dignity of individual;
- (b) faith in man's ability to make rational decisions;
- (c) respect for the dignity of labour. (FRN, 1998, P.8)

In the area of implementation, the government is to ensure, among others, that:

- (a) Life long education will be the basis for the nation's education policies;
- (b) Educational activity will be centred on the learner for maximum self-development and fulfilment.
- (c) Modern educational techniques will be increasingly used and improved at all levels of the education system. (FRN, 1998, P.9)

From the above discussions, several challenges confront the state and direction of education in Nigeria, the basic one being how to make institutional education curriculum and teaching strategies prepare learners for useful living. This is because knowledge, that is scientific and technological, has become virtually the most important factor today in economic development. Thus, this paper sets to propose teaching strategies that will prepare learners for scientific literacy and useful living. This, we believe, must start from making learners active participants within the teaching-learning milieu. The basic assumption is that for students to solve problems, they must be given a lot of opportunities to be involved in problem-solving exercises; and for science-oriented society, learners within the school institutional set-up must be brought-up scientifically and technologically literate as active participants.

The proposition is that the "traditional patterns of science education have contributed to widespread scientific illiteracy among students and adults" (Rasmussen, 1995, P.2). This is because the traditional instructional strategy is rooted in the behaviourist theory and encourages didactic teaching, teacher-centred classrooms, concept-based instruction and rote methods of learning (Christensen, 1995a). A clear change of methodology is therefore advocated, taking cognisance of modern trends and developments in pedagogy. As have been noted in the United States of America, a new vision of science learning is emerging, and it calls for instructional strategies far different from most traditional

conceptualizations (Christensen, 1995a). In this era of globalization, Nigeria must move with this modern current so as to bridge the development divide.

### SCIENTIFIC LITERACY AND KNOWLEDGE CONSTRUCTION

Teaching strategies are integral parts of the curriculum process, and it is the area in which the teachers are often most concerned and where his professional abilities are clearly stressed to determine their effectiveness. That is, the teacher is an important agency which can make or mar successful learning within formal institutional education. His personality and method has direct and cumulative impact on the lives and learning habits of pupils. For example, Bernard (1972), after a wide study on the impact of teachers and teaching methods on students' academic behaviour concludes:

An effective teacher can be a marked and positive influence, a poor one can contribute to pupils disliking school and formal learning, but many teachers might just as well not have been there (Bernard, 1973: p. 251).

Thus, how can we make teachers in our school system very effective so that their influence might be felt positively in their build-up to "sound and effective citizens" who are able to 'make rational decisions'? We believe that the basic propositions of constructivism, which put the students, their interests, and their previous experiences and knowledge into consideration in their education, offer the best promise.

As found elsewhere, especially the United States of America, constructivism, with an emphasis on teaching through inquiry, has become a vital component in developing a more complex pedagogical content knowledge for the teaching of science (Eick, 2000). As a substantive change in how science is taught and in professional practices, it emphasises bridging the gap between the pedagogical and content aspects of science teacher preparation by advocating the development of cohesive knowledge base (Doster, Jackson and smith, 1997).

The inadequacies of traditional programs led to the intense criticism of America's schools following the publication in 1983 of 'A Nation At Risk' (cited in Christensen, 1995a). The criticisms led to the unprecedented reform in science education from the early 1990s (Rasmussen, 1995) and the publication of two important science programs among others: Benchmark for Science Literacy (AAAS, 1993) and National Science Education Standards (NRC, 1996). The two programs propose a new view of science learning based on a growing body of research on how students learn. According to Christensen (P.3) "These standards support a constructivist approach, which view knowledge and understanding as growing from inquiry and investigation... emphasize learner-centred classrooms, problem-based learning and the construction of understanding and meaning by standards".

In another work, Christensen (1995b) expounded on the benefits of constructivist learning. He argued that the goal of education for the 21<sup>st</sup> century America is to make citizens

increasingly think **critically and strategically** to solve real-world problems. Thus, **the new vision for science learning** in response to the **21<sup>st</sup> century** needs is that for learners to acquire **specific knowledge and understanding**, they must be provided with the **opportunities** to do so through the process of dealing with **authentic problems**. This, he argued, is succinctly provided by the **constructivist learning approach**.

Constructivism is a set of intellectual referents for making decisions in relation to actions. According to Crowther (1997: p. 2) "Constructivism means that as we experience something new we internalise it through our past experiences or knowledge constructs we have previously established". Thus, the emphasis of constructivism is how the students, their interests, and previous experiences and knowledge can be brought together to improve the acquisition of knowledge.

In science, many scholars have variously defined constructivism. For example, Tobin and Tippins (1993, p. 4) define constructed science knowledge "as a set of socially negotiated understandings of the events and phenomena that comprise the experienced universe". So also, Scott (1987, p. 65) defines constructivism in science as follows:

Constructivism perceives students as active learners who came to science lessons already holding ideas about natural phenomena, which they use to make sense of everyday experiences... Such a process is one in which learners actively make sense of the world by constructing meanings.

Thus, the emphasis of constructivism is to present students as active rather than passive learners; in which students, their interests, previous knowledge, experiences and world views are taken into consideration in the acquisition of new knowledge.

Wheatly (1991, p. 9) proposed two principles of learning through constructivism. According to him:

Principle one states that knowledge is not passively received, but is actively built up by the cognising subject. Ideas and thoughts cannot be communicated in the sense that meaning is packaged into words and 'sent' to another who unpacks the meaning from the sentences. That is, as much as we would like to, we cannot put ideas in students' heads, they will and must construct their own meanings ... Principle two states that the function of cognition is adaptative and serves the organization of the experiential world, ... Thus we do not find truth but construct viable explanations of our experiences.

As a follow up to these learning principles, Wheatly (1991, p. 13) proposed a model of constructivist teaching, using the problem centred learning approach. He agreed with Kozmetsky (1980) that learners must be encouraged to build their own conceptual constructs that will permit the ordering of knowledge into useful problem solving schema. His research findings in America indicate that higher order objectives are better achieved with the constructivist learning method than the traditional behaviourist approach. This is because in the

constructivist approach, teachers emphasize authentic instruction and the elements that promote high performance and successful learning among students. He then proposed what the role of the teachers should be in the process. To him, the role of the teacher is to "provide stimulating and motivational experiences through negotiation and act as a guide in the building of personalized schema" (p. 14).

In another study, Christensen (1995a) argued that the constructivist teaching and learning approach is a new paradigm for science learning and that it emphasizes engagement and meaning in ways that are not consistent with past practices. He argued that the "outcome of this new approach to learning is a higher level of student achievement in the sciences" (P.1). The challenge, therefore, according to Christensen is to define this new approach to teaching and learning with sufficient clarity that it becomes a useful vision for educators as they make decisions about instructional materials, activities, and strategies for decision.

The following guides are therefore provided to assist teachers to produce stimulating and motivational experiences within the purview of constructivist teaching and learning:

- (1) Science teaching should endeavour to address the question of relevance in instruction. This is because pupils learn better when the objects to be studied are of interest in solving personal or social problems. This is the essence of the constructivist notion of engaged learning and authentic instruction (see Kozmetsky, 1980 and Wheatley, 1991).
- (2) Instruction in science should value students' point of view and look for what they can generate, demonstrate and exhibit.
- (3) All children should be treated as possessing scientific imagination requiring tending and maturation.
- (4) Provide problem set for the learners coupled with immediate reinforcement for correct or incorrect responses.
- (5) **Present problems in a structured fashion to students beginning with the easiest and familiar to the more difficult. Each stage should be mastered before progression to a higher stage.**
- (6) Based on the Piagetian theory, knowledge to be acquired should be presented sequentially to match individual's existing level of thought.
- (7) As specific knowledge and understanding are acquired in the process of dealing with authentic problems, so pupils should be provided with plenty of opportunities to undertake both personal and social problem-solving exercises using science.
- (8) Authentic problem solving activities should be varied to sustain pupils' interest.

## CONCLUSION

The challenge of building a science-oriented society in Nigeria is daunting. The challenge requires that the Nigerian science educators should begin to redirect their pedagogical machinery to move the nation forward in the arena of science and technology in consonant with changing global trend and pattern. As have been shown above, new

orientation in science learning is emerging, with emphasis on instruction that emphasizes engaged learning, in which students create meaning from their own experiences (Christenson, 1995a). This hands-on, minds-on and authentic learning allows students to develop critical thinking processes as they perform science through knowledge construction and problem-solving activities. This constructivist approach to teaching and learning science is therefore advocated for Nigerian schools as the best way to build a science-oriented society.

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