IDEAL INTERNATIONAL JOURNAL of IGBO SCHOLARS FORUM, NIGERIA Volume 16, No. 2, June, 2023 ISSN: 2476-8421

PARADIGM SHIFT IN SCIENCE EDUCATION TEACHING AND LEARNING IN NIGERIAN SENIOR SECONDARY SCHOOL IN THE 21ST CENTURY: A PRAGMATIC APPROACH.

Abubakar O. Ari
Department of Educational Foundations
University of Nigeria, Nsukka.
abubakar.ari@unn.edu.ng +2348137200235,

Bridget O. Dioka
Center for Igbo Studies
University of Nigeria, Nsukka.
bridget.dioka@unn.edu.ng +23490933217027,

Abu A. Usman
Department of Educational Foundations
University of Nigeria, Nsukka.
usmanabiabu@gmail.com +2348065523088

&

Jimba D. Noah
Department of Educational Foundations
University of Jos
jimbadaku@yahoo.com +2348064664325

Abstract
This paper focuses on the importance of paradigm shift in science education teaching and learning in Nigerian senior secondary schools. The areas of science education and the intended policy as contained in the national policy on science and technology education as it contributes to the development

of the society were highlighted. The paper made plea that, for adequate teaching and learning of science education, policy, curricula content would have to be amended to reduce dependence on text books and include the doctrine of an ethno-science. Traditional teaching format in classrooms which focuses on passing examinations, should be discouraged and assessment which, covers higher levels of cognitive, affective and psycho-motor ability be encouraged. Above all, funding should be adequately and promptly provided for the effective teaching and learning to be carried out.

Introduction

Science is a body of knowledge and process studied for the possibilities it offers for the development and advancement of technology. It is a way of providing explanation for certain events, occurrences and phenomena in nature using acceptable laws, principles and practices. Science education was introduced into our school curriculum by the colonial administrators whose interest and objectives were not necessarily the same as those needed for development of the nation. As Bajah (1982) cited in Sekegor (2010) claimed that the rudiment of science at that time was nature study that involved the teacher and pupils learning about the environment in form of observation of plants, animals and non-living things. In this way, the teaching of science was not coordinated, neither was it focused. The present teaching and learning of science education in Nigeria senior secondary school science, advocate for a paradigm shift in the way science is taught in schools for the citizenry to acquire a knowledge-based economy and innovative skills for productive venture.

Concepts Classification

Science education

Science education can be seen as a systematic way of acquiring knowledge about natural world. Accordingly, Ennosho (2009) defines science as an organized body of knowledge about the world, a set of logical and empirical methods for the investigation and understanding of natural phenomena and an enterprise for the application of scientific knowledge. Science has been, and would continue to be of tremendous importance because of its ability to explain many natural occurrences and the central role it plays in the world's current technology development.

Science education is a field of study concerned with producing a scientifically literate society. Ezeh (2005) cited in Sekegor et' al (2010) defined science education as the process of utilization of both pedagogic principles and content knowledge in science to impart scientific facts, theories and laws of nature. It is one of the indispensable tools for national development. It has been employed by various countries of the world to solve their various national problems such as discrimination, social justice, poverty, diseases, breakthrough in science and technology, economic stability and so on. Science education involves the study of some science and in addition, educational disciplines that relate specially to how scientific knowledge and concept are learned and verified; how scientific concepts are programmed for understanding and how science curricula can be meaningfully evaluated.

There is symbolic relationship between science and technology…. Science and technology hold the key to the progress and development of any nation. Technology which is the product of science plays a fundamental role in wealth creation, improvement of the quality of life and real economic growth and development transformation in any society. The ability of a country or countries to improve the social welfare

of the people is known as national development. The national policy on science education as contained in the national policy on education (FRN, 2014:29) States that: science education shall emphasis 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 goals of science education shall be to:

1. Cultivate inquiring, knowing and rational mind for the conduct of good life and democracy
2. Produce scientist for national development
3. Services studies in technological development, and
4. Provide knowledge and understanding of the complexity of the physical world, the forms and conduct of life.

A critical assessment of the present teaching and learning of science education in Nigeria senior secondary science curriculum, advocate for a strong science and technology education (S&TE) System for the citizenry as a prerequisite for a knowledge–based economy and innovation. This is because almost all facts of the society are technology driven; commerce, manufacturing, industrial and provision of goods and services to industry. By this token according to the national policy on science and technology education (S&TE), is argued to be central to the industrial development of any country, therefore, there is need for paradigm shift in the delivery of science and technology education in Nigeria to meet the current global technological explosion through an all-inclusive functional science policy.

Science education curriculum is expected to equip learners with skills that will make them self reliant, prepare them to enter into jobs and this means that the curriculum should prepare the learner for entrepreneurship. The big snag here is that the curriculum operated in Nigerian senior secondary schools is based on European culture which significantly differs from the culture where it is executed. As

a result, students find it difficult to relate what they already know to what they are to learn due to cultural setting or environmental factors. Most practicing science teachers do not posses adequate training for the job. Since the science world is continuously changing, teachers require to be constantly training and retraining to update and upgrade their knowledge in the job and in the teaching and learning of the content to be facilitated. It is common adage that no education system can raise above the level of its teachers.

Science education has made significant progress in agriculture, health, energy, water, and environment to alleviate poverty. Advance in scientific knowledge and its application have helped in solving the trends of high infertility, high morality, and greater efficiency in agriculture to increasingly better health. Science teaching has both content aims and process aim. The guiding principle should be; connecting knowledge to life outside the school; ensuring that learning shift away from rote learning method; and enriching the curriculum so that it goes beyond textbooks. This indeed is the crux of this paper, as has been argued that the Nigerian concept of scientific knowledge is bits of information which students increasingly acquire from the teachers' notes and textbooks, and religiously return to sender at examinations, thereby obtaining one certificate or the other for white collar job.

This is no longer tenable at this very level of our scientific awareness; ways and means in which science education is taught at senior secondary school should therefore, involve a radical change in the teaching and learning of science. Thus, it means a significant change in theory or practice when the usual way of thinking about doing something is replaced by a new and different way. There are various factors that can lead to paradigm shift in teaching and learning such as globalization, industrialization, labor market demands, population explosion and social changes. The

challenges of science education are to bring the range of young people a comprehensive of the nature of science as a humanistic enterprise. This is in line with the intended goals of F.M.E (2019) as cited in Nwachukwu stated thus,

> ……If children are to learn science ……we must give them respect for observation rather than the pronouncements of the textbooks and teacher prophets ……we must see to it that children understand experimentation as a means of compelling nature to answer their questions …….children must know that no one really knows. If we can give children this insight, they will have learnt science, no matter what content they have covered''.

In senior secondary school, students are introduced to basic scientific skills of observation, classification, recording, measurement, interpreting data, analyzing and hypothesizing. These skills are assumed, would possibly prepare learners to take part in classroom activities that can enable them develop value-laden science attitudes to achieving life-long careers. If learners are effectively engaged with scientific skills in the school, they are likely to develop their areas of interests early and improve upon what they already know. When this happens, learners are then able to engage in classroom and out-of-school activities. This facilitates and broadens learning experiences and builds capacities for scientific literacy, self-reliance and community sustenance. Promoting the use of scientific literacy skills in the school curriculum, will promote the development of intellectual and practical skills needed for survival.

Nigerian school system does not give priority to scientific knowledge, understanding and application of science in relation to the immediate environment. For instance, what is being taught in senior secondary school is continued

to be taught in Western science without reconnect to Nigerian peculiar environmental conditions, aspiration, ambition and so on. Many developed countries of the world (For example, Malaysia, China, Japan, Brazil, and Russia) are argued to be great scientists and their scientific horizon of literacy skills. These scientists developed their level of development through the adaptation of technology and development of an efficient Science and Technology Education (S&TE) capacity. Science education in other climates is said to be practically oriented than theoretical. The development of critical thinking, practical and communication skills is an important aim of science. These processes are vital to science teachers and learners. Science students should be able to use certain tools, make and record accurate observation inform of hand-on-method of teaching and learning. Hand-on-activities are very rare in the Nigerian senior secondary schools. This is because of the following reasons: Non availability of materials, lack of funds for procurement of scientific equipment for practical, in-adequate preparation of teachers in science subjects.

Teaching and learning of science

Teaching of science is crucial for developing scientifically literate citizens and improving the economic productivity for sustainable development. The teaching and learning of science education in Nigerian secondary school depends on the quality of teaching by the science teachers. Darling-Hammond (1999) cited in Ogunmade (2005) notes, quality teaching is crucial in enhancing students' achievement and strengthening public confidence in schools. Adegbamigbe (2002) defines quality teaching as a series of dynamic processes and activities of teachers' actions within the educational context with a view to enhancing quality of students' learning and promoting job satisfaction. Ogunmade (2005) argues that quality teaching involves teachers who are competent with adequate knowledge and skills needed for

effective classroom management, pupil assessment, subject teaching, and those who engage in regular professional learning. The quality teaching encompasses prior knowledge activation, hands-on learning, and continuous reflection.

The National Commission on teaching and America's future (NCTAF, 1997) also corroborates that high quality teaching involves teachers that: have better and sound knowledge of the subject matter content and pedagogical strategies; have adequate understanding of what the learners know and need to learn; create a challenging and supportive classroom learning environment; and regular reflection on their teaching and student's learning. Quality teaching basically, is a process that helps teachers to focus on the educational improvement of learners through the integration of adequate knowledge of the curriculum content areas, functional pedagogic skills, critical reflective teaching empathy and commitment to the educational process, and the acquisition of managerial competencies within and outside the school context.

From the above, therefore, it is clear that quality teaching fundamentally involves teachers' knowledge of content and pedagogical skills, knowledge of the curriculum and effective supervision and classroom management as well as reflection to improve the learning outcomes of the learners. These assertions in the National Science Education Standards indicate a paradigm shift from the behaviorist approach to teaching where students remain passive recipients of teacher-generated knowledge followed by drill and practice, to constructivist approaches wherein students engage in constructing knowledge of science from their prior experience and the teacher acts as a facilitator, scaffolding students' learning.

Qualities of science teachers therefore are knowledgeable about science, learning and science teaching and they create an environment where students are regarded

and treated as active learners. Quality teaching and learning in science thus involves teachers' knowledge of subject matter and teaching pedagogy. However, as already stated, the greatest weakness of our educational system throughout the intervening generation lies in its implementation weakness, over dependence and inadequate philosophical principles, especially constructivism epistemological orientation. Constructivism is an epistemology, a theory of knowledge from their heads to the learner and that knowledge is constructed by the learner. Constructivist theory claims that understanding comes from a person's effortful activity to integrate newly communicated claims and ideas with his own prior belief and understanding.

The effective learning occurs only when the learner develops, constructs and accommodates meaning in a context that builds on their prior knowledge. Tytler (2002) argues that to develop a new understanding, there is a need for learners to be encouraged to extend their prior knowledge to a new situation. In that view, understanding cannot be transmitted nor does skills practice result in understanding which can be automatically applied as needed. Instead, effective teaching and learning involves creating environments in which students take mindful efforts towards developing their understanding and have opportunities to learn how to apply their knowledge and when to do so.

Paradigms shift in Science Education teaching and learning in Nigeria.

Science education is the process of teaching and learning. It is the most powerful tool to change behaviour, impact or acquire knowledge and develop intellectually for life with the current standard of science education. What learners achieve and how effective and functional science education is, there is no doubt that there are better and

effective ways to educate learners than the current school model. The current science education curriculum basically involves teaching mostly theoretical content assumed to be worthwhile knowledge like mathematics, science and language Arts while ignoring knowledge that can adequately equip learners with skills useful for future. However, science education is no longer defined in terms of what a teacher will teach but rather in terms of what student will be able to demonstrate.

There is therefore a set of scheme of work, syllabus, course content and a time table. Inevitably, slower learners are forced to move on before they have mastered the content, and they accumulate deficits in their learning that it is more difficult for them to learn related content in the future. In spite of great technological breakthroughs, most of secondary education in Nigeria continues to embrace traditional education model as the right way of teaching and learning of science education. It takes a long time for institution such as senior secondary schools to change from the status quo but then, this change seems to be imperative. Although originally limited to science education, the idea of a paradigm shift has been applied to other areas of understanding. Thus, it is a significant change in theory and practice when the usual ways of thinking about science are replaced with a new scientific method of teaching and learning. There are various factors that can lead to paradigm shift in teaching and learning of science in the 21st century based on globalization, industrialization, labour market demands and social changes.

The 21st century teaching and learning has teachers and students who are changing rapidly. It is a common saying that the only thing that is permanent is change. In this new paradigm, the secondary schools authorities must create enabling environments and experiences that bring students to discover and construct knowledge for them instead of one that merely transfers knowledge from faculty to students.

Therefore, it is argued that senior secondary schools must undergo a paradigm shift from instruction paradigm to learning paradigm, from being an institution that provided instruction to students to an institution that produced learning in students for productive skills, which covers higher levels of cognitive, affective and psycho-motor ability. While the instructional paradigm often focuses on increasing the quantity of information, the learning paradigm focuses on the efficiency and effectiveness of the learning process regarding what does the students know and what can they do with the new information learned.

However, given the nature of secondary schools in Nigeria, the impediments to this paradigm shift are formidable. Some of the challenges facing the implementation of this shift are that many of the traditional administrative and instructional structures are steadfast and deeply entrenched and the fact that teachers and administrators have been trained and students have been schooled within the old paradigm. Paradigm can be described as a model or pattern for teaching and learning that may be copied; a theory or a group of ideas about how teaching should be done, made or thought.

According to Huitt (2011) cited in Adeyemi et'al (2019) a paradigm may be thought of as pattern or model of how something is structured (the parts and their interrelationships) and how the parts function (behaviour within specific context or time dimension). Adeyemi further defined paradigm as a constellation of concepts, values, perceptions and practices shared by a community, which forms a particular vision of reality that is the basis of the way a community organizes itself. New roles for teachers for the new paradigm of instruction, the teachers' role has changed drastically in the new paradigm of instruction. Schleckty (2002) cited in Adeyemi et' al (2019) identified three major roles of the teacher as designer, facilitator and mentor. Different kinds of teachers with different kinds and levels of

training and experience may focus on one or two of these roles.

i. The teacher is a designer of student work which includes that which is done in both the task space and the instructional space

ii. The teacher is a facilitator of the learning process which includes helping to develop a personal learning plan, coaching or scaffolding the student's learning when appropriate, facilitating discussion and reflection, and arranging availability of various human and material resources.

iii. Perhaps the most important in the public education sector is that the teacher is a caring mentor, a person who is concerned with full, well-rounded development of student.

New roles for students for the new paradigm shift of instruction, the students' role has also changed in the new paradigm of instruction. The role of the teacher is therefore not instruction but rather that of producing learning with every student by whatever means work best. Teachers are to be guided on the side instead of a sage on the stage. According to Schlechty (2002) cited in Adeyemi et 'al (2019), new students' roles include student as worker, self-directed learner, and teacher.

i. First, learning is an active process. The student must exert effort to learn. The teacher cannot do it for the student. This is why the students is the worker, not the teacher, and that the teacher is the designer of student's work.

ii. Second, to prepare the student for life-long learning, the teacher helps each student to become a self-directed and self-motivated learner. The old paradigm systematically destroys self-motivation by removing all self-direction and given students boring work that is not relevant to their lives while the new paradigm

nurtures self-motivation through self-direction and active learning in the context of relevant and interesting tasks in learner.

iii. Third, it is often said that the best way to learn something is to teach it. Students are perhaps the most under-utilized resources in our secondary school systems.

The need for paradigm shift in science education in Nigeria which covers higher levels of cognitive, affective and psycho-motor domain in students' ability to learn and understand the scientific skills. Thus, information technology is not widely accepted in the senior secondary schools in Nigeria for various reasons in spite of the numerous advantages. Therefore, there is a need for paradigm shift model of innovation, invention and creative skills in learner by incorporation of information and technology skills into teaching, learning and Research & Development (R&D). It is important to state here that all traditional methods do not need to shift but the valuable methods can still be practiced in the modern classroom to sustain humanity. So any paradigm shift should not make distance between the teacher and the students, no paradigm shift should replace a teacher in teaching and learning process.

Using Pragmatism approach as Synergy for way forward

In spite of the enormous challenges confronting science education in Nigeria, there are great prospects for science and technology education in advancing scientific literate nation. Development of an effective science education framework should be based on the following context; the nature of the learners, the environmental factors influencing the learner, the nature of the society, the nature of accumulated knowledge available, information about the teachers and the nature of the school system.

To the pragmatist, science curriculum should be planned in such a manner that it teaches the learner how to think critically instead of what to think. Teaching in this sense should be more exploratory in nature than it being explanatory. Here, learning takes place in an active way since learners solve problem that helps them broaden their epistemological horizons and accordingly reconstruct their experiences in consonance with the dynamic or changing world. From this therefore, the question becomes, what then will be the role of the teacher for effective teaching and learning? The role of the teacher will not just be to disseminate information but to construct situations that involve both direct experience with the world of the learner and opportunities provided to comprehend these experiences. Pragmatism therefore emphasizes experiences, consequences, verification, and workability as terms that portray its major concepts. All these and only those things that possess the above terms are things that science students can know.

Recommendations

Adequate Funding of science education policy: Government should equip the schools with adequate information and communication technologies gadgets including computers and Internet access so that teachers and learners would be able to find information beyond the resources of the school. Funding should be made a top priority of government. This will ensure necessary infrastructure; classrooms, materials and other necessities can be procured for students and be made available with little or no cost.

Improvisation of instructional materials: In view of the persistent limited allocation to the education sector in Nigeria, government should increase the allocation to the sector so as to give room for increase in the running grant for science

education and ensure the provision of more instructional materials and facilities for effective teaching and learning of sciences. Improvisation of instructional materials is inevitable in teaching and learning of sciences in Nigeria schools. Teacher of science is therefore responsible for some materials that are not available. Improvisation is an attempt to make a replica of real things in the process of providing for unavailable material. Locally made materials may be used if commercial materials are not available because of financial implications to perform all functions of the original materials. Government should equip the schools with adequate supplies of equipment and reagents in the laboratories for practical work in science. Also, there should be laboratory assistants in all schools to help with the proper maintenance of laboratory facilities and equipment and also to assist in the preparation for practical experiments so that teachers include more inquiry-based practical work for students in science.

Consistency of Government policy towards curriculum planning and implementation: Governments at all levels must review their policies on science education and put in place appropriate policies on science and technology with appropriate policy implementation and monitoring frameworks. Government, therefore, has to increase on science education for quality assurance, and give science teachers motivations that would make them to be responsive to changes in their classroom practices and enhance science learning in the secondary school. The content of senior secondary school science curriculum should be reduced as they contain more concept and fact whose examples are foreign. Doctrine of ethno-science should be included. In the school, most of the things the learners are exposed to, are contained in the curriculum and they should be organized, controlled and supervised by the teacher.

Conclusion

The 21st century teaching and learning demand that qualified trained teachers effectively manage the core areas of the required competencies. Science education programmes in Nigeria classroom has gone through paradigm shifts, many of which were as a result of the evolvement of new learning process. There is the clarion call to shift from instructional paradigm to learning paradigm as a result of which new roles have emerged for the teachers and students. Some paradigm shifts have taken place in secondary education in form of innovative process. In view of the special needs to learners in the 21st century and other important factors, there are more calls for paradigm shift globally and Nigeria in particular. It can be concluded that paradigm shift in the 21st century classroom is imperative and must be functional not theoretical.

References

Adegbamigbe, A. B. (2002). Teachers perceptions of quality teaching in junior secondary school physical education in Lagos state, Nigeria. Unpublished PhD; Edith Cowan University, Western Australia.56-43.

Ayozie, B. (2002). Situational Analysis in Curriculum Development and Planning. In G. C. Offorma (ed.). Curriculum theory and Ppplanning. Onitsha: Uni-World Publishers.

Hashimi, A. M. (2018). Challenges of Educational Development in Nigeria: Issues of Chemical Sciences. Chemistry and Materials Research ISSN 2225-0956 (online) Vol. 10(3)

National Commission on teaching and America's Future, (NCTAF, 1997). What matters most: Teaching for America's Future, New York: NCTAF.

Ogunmade, T. O. (2005). The status and quality of secondary science teaching and learning in Lagos state, Nigeria. 67-71.

Olusegun, A. F. (2019). The imperative of paradigm shift in the 21st century classroom. In B. A. Adeyemi; J. O. Adeyanju; F. O. Aladejana, & P. O. Jegede. Education in the 21st century. Obafemi Awolowo University press Ile-Ife Nigeria.19-22.

Sekegor, C. O.; Agadaigho, A. & Ogaga, P. (2010). Implementation issues in science education: Problems and prospects. Multidisciplinary Journal of Research Development.14 (1), 110.

Tytler, R. (2002). Teaching for understanding in science: Constructivist/conceptual change teaching approaches. Australia Science Teachers Journal 48(4), 30-35.