

INNOVATIVE PRACTICES IN SCIENCE EDUCATION: A PANACEA FOR IMPROVING SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN SCIENCE SUBJECTS IN NIGERIA

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ABSTRACT

Innovative practices are those actions or activities engaged by man through which new inventions are introduced into the society. Innovative practices can be seen in the areas of; Health, Communication, Agriculture, Industry, Governance, Education etc. This present paper was developed to examine innovative practices in science education which was identified as a panacea for improving students' academic achievement in science subjects in secondary schools in Nigeria. The expository write-up examined innovative practices in science education in the areas of; science education curriculum, science teaching and learning, and improvisation in science education. The paper pointed out that when teachers adopt innovative practices in science education, the students' academic achievement are greatly enhanced. The paper concluded by suggesting among other things that science teachers should utilize innovative practices in their lesson delivery so as to enhance students' active participation in the lesson which will bring about an improved academic achievement. Also, intensive in-service programs should be organized to get the science teachers acquainted with and trained on how to effectively utilize innovative practices for enhanced students' academic achievement in science subjects.

KEYWORDS: Academic achievement, curriculum innovation, innovative practices, science education

INTRODUCTION

Innovation, according to the United Nations Education Science and Cultural Organization (UNESCO) in Okoye (2012), is a general change that is deliberate and must never be regarded as simple adjustment. Continuing, UNESCO added that innovation refers to any persistent change in the patterns of behavior of members of an identifiable social system. It is a novel departure from a customary practice that can be sustained for some time which is situational and relevant to a group in time and place, and when widely adopted, it becomes a reform. Innovation is a technique, idea, a practice or an object that is perceived by an individual or another unit as new (Nwafor, 2007). Microsoft (2009) sees Innovation as the act or process of

inventing or introducing something new. It is also a new invention or way of doing something. Furthermore, Innovation is a change in the thought process of doing things or the useful application of inventions and discoveries (McGeown 2011). From these definitions, it implies that when new inventions and discoveries are put in practice, or a successful introduction of a better thing/method, therefore, innovation could have taken place. Innovation is also a process that renews or improves something that exists. It is the act of introducing new ideas in order to improve or make an existing one more effective. Contributing, Okwor (1996) stated that, Innovation refers to a new technique, method or approach deliberately designed and developed to improve effectiveness and efficiency in a given setting. Innovation is equally the introduction of

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new ideas or ways of doing something that has been discovered or introduced. It could be new ways of teaching, production, construction etc. It must be an improvement to the existing one and must be in the positive direction. Innovation is necessitated by the need for improvement.

From the foregoing, Innovation therefore is an idea that is new to a situation. It is the introduction of new ideas which can take the form of process, programs, products, the means or ends. An innovative approach may be entirely a new package, or an old approach with new ideas harmoniously integrated or aspect of old and new ideas holistically integrated to improve effectiveness or efficiency. Innovative practices are therefore those actions or practices engaged by man through which new inventions are introduced into the society. Innovative practices can be seen in the areas of; Health, Communication, Agriculture, Industry, Governance, Education, etc. This paper discussed innovative practices in education, specifically in science education.

Innovation in Education according to Nwafor (2007) is a deliberate, systematic, novel, specific and persistent change in the system of a particular society, which is aimed at improving the system or creating a new one, for a more effective and efficient means of attending to the educational needs of the social group, in their social environment. In their opinion, Kirsi and Seppo (1996) stated that Innovation in Education is a creative, new educational innovational policy, a creative way to renew education, a creative solution, a creation of new educational culture, a new opening, and a new idea to overcome some problems in education. Continuing, Kirsi and Seppo maintained that Innovation in Education is a starting power, an idea that makes things move. Adoption of an innovation in education means to take up or accept an innovation and make use of it in the educational sector. It simply means having new creative ideas implemented. This is necessary because a healthy system should tend towards inventing new procedures, move towards new goals, produce new kinds of products, diversify itself and become more rather than less differentiated over a period of time (Ochitwa in Okoye 2012). According to Nwafor (2007), it is necessary to adopt innovations because the needs and problems of the society changes from time to time. Education therefore should change to meet the changes of the society. The adoption of innovations in education offers the educational institutions the opportunity

of making changes or improvement in the educational sector. This is because it is when innovations are widely adopted that the reforms that have always been desired in the educational sector will be achieved. Therefore, any move in education to accommodate new knowledge, remove obsolete ones and adopt multi-disciplinary orientation is likely an innovation in education.

Innovations in Education therefore are new, creative ideas which are meant to bring effectiveness and change to the educational sector. They can simply be said to be the new things in the educational sector meant to bring more efficiency and effectiveness. Meanwhile, research studies have shown that students' academic achievement in the three core science subjects (Biology, Chemistry and Physics) have been very poor with little or no appreciable improvement over the years (Jegade, 2010; Olorundare, 2014; Oloyede, 2010). It is believed that innovative practices in science education can help to enhance the students' academic achievement in the science subjects. This paper therefore, discussed the new things introduced into science education for more efficient and effective academic achievement of students.

Innovative Practices in Science Education

Science Education has been recognized, the world over, as a prerequisite for scientific and technological development. It provides opportunities for students to acquire relevant functional knowledge and skills that are associated with scientific processes needed for advancement in science and technology. In science education, students are encouraged to acquire and practice the scientific skills. Science education is concerned with finding answers to problems in a bid to understand and interpret natural phenomena (Eze and Akubue, 2007).

Science education should therefore, inculcate self-discipline, scientific literacy and commitment in the minds of students. To achieve these, science teachers have to convert science teaching into sport and learning process that has to generate interest in the students and motivate them to stay back in the science discipline than to run away from it. Science education should become fun and thrilling to the students rather than burden and boredom. Science education is an engine for the growth and progress of any society. It not only imparts knowledge, skills and inculcates values, but is also responsible for building human capital which breeds, drives and

sets technological innovation and economic growth of any nation (Eze and Akubue, 2007). In today's era, information and knowledge stand out as very important and critical input for growth and survival. Rather than looking at science education simply as a means of achieving social uplifting, the society must view it also as an engine of advancement in an information era propelled by its wheels of knowledge and research leading to development. This change in focus of science teaching and learning is an aspect of innovative practices.

Innovative practices in science education were discussed under the following sub-headings;

- i) Innovative practices in Science Education Curriculum
- ii) Innovative practices in Science Teaching and Learning
- iii) Innovative Improvisation in Science Education

i) Innovative Practices in Science Education Curriculum

Curriculum is a plan developed with the intention that when it is properly executed, the educational goals will be achieved. It represents the total experiences to which all learners must be exposed; the content, performance objectives, activities for both teachers and learners, teaching and learning materials and evaluation guide are provided (Ejidike & Oyelana 2015). Offorma (2005) described curriculum as a vehicle through which education takes place. It is the totality of the environment in which education takes place. Continuing, Offorma maintained that curriculum involves the learner, the teacher, the content, the subject, the resources, the methods of teaching and evaluation, as well as the physical and psychological environment, which must be adequate and conducive for learning to take place.

Meanwhile, Science education curriculum is expected to equip learners with skills that will make them self-reliant, prepare them to enter into jobs and progress in them. This means that the curriculum should prepare the learner for entrepreneurship. Unfortunately, Adeyegbe (2004) stressed that the curriculum operated in Nigerian schools was based on European culture which significantly differed from the Nigerian culture where it is implemented. As

a result, students find it difficult to relate what they already knew to what they were to learn due to cultural settings. In other words, the curriculum could not achieve the purpose for which it was meant. Moreso, Adikwu (2008) added that the problem with science education is lack of good curriculum. Adikwu maintained that curriculum must be developed, and that there should be a readily-available inquiry-based innovative curriculum. This is because one of the reasons for the innovations in the science education curriculum is to introduce modern scientific techniques.

The science education curriculum has under gone some innovations and modifications in the area of contents pattern, implementation and revision. The innovations were as a result of the changing needs of the society. It can be deduced that the need for the innovations of the curriculum was as a result of three major issues shaping the development of nations worldwide and influencing the world of knowledge today which were identified as globalization, information and communication technology (ICT) and entrepreneurship (Federal Republic of Nigeria, FRN, 2009). Nigeria being one of the developing nations does not want to be left out, thus the innovations in the science curriculum, to be in line with the needs of the Country.

Furthermore, the curriculum is packaged with content that leads to self-actualization by students. In addition, the curriculum content focuses on practical activities with emphasis on locally available materials. This is to imbue the learners with the spirit of inquiry. From the foregoing, teachers of science therefore need more than just being aware of the use of Information and Communication Technology (ICT) as enriching agents in the curriculum or as a tool for instruction. They have to lead in the active development of innovative teaching and learning materials using ICTs and also in constructing a rich and enabling learning environment for the students. The emphasis should now be placed on interactivity, practical laboratory activity and applications of science and technology to the environment and development needs of the country. Moreover, the contents of the innovations in the science education curriculum should be relevant to the needs of the nation. This is because the development of the nation is determined by the developments in science and technology education.

ii) Innovative Practices in Science Teaching and Learning.

The core objective of teaching is passing on information or knowledge to the minds of the learners. Any method using computers or modifying the existing conventional chalk-talk method are innovative if they ultimately serve the attainment of core objective of teaching (Okoye, 2012). In the conventional methods of teaching, the teacher controls the instructional process, the content is delivered to the entire class and the teacher tends to emphasize factual knowledge. In other words, the teacher delivers the lecture content and the students listen to the lecture. Thus, the learning mode tends to be passive and the learners play little part in their learning process (Aniodoh, 2001).

In the teaching of science, teachers are expected to have a good level of competence and mastery of the subjects before introducing it in the classroom. This will enhance effective teaching of the subjects in the secondary schools. Teachers need to excite the interest and attitude of the students with regard to the subjects through their modes of teaching. The teachers are expected to be experts who have good exposure and experience in science. They are also expected to use innovative teaching strategies which will help to foster the adjustment of students, matching curricular offerings to levels of mental development, understand students' basic cognitive and social problems, making curricular specifications relevant, and motivate the students in the learning of the subjects (Nwachukwu, 2009).

Awoniyi in Okpala (2006) observed that to be effective, the teacher has to be many things: a source of information and a guide, an organizer of opportunities for learning, someone who can structure a suitable environment for learning, a superior and a consultant. The teacher has to be conversant with innovations in science teaching and learning so as to be able to determine the most suitable strategy for an effective lesson delivery. As the teaching strategy adopted by a teacher either promotes or inhibit learning, teachers must use different innovative teaching strategies that will help to arouse the students' interest and encourage them to develop positive attitude for effective learning outcome.

For effective teaching and learning to take place in the science classroom, the teacher is expected to communicate effectively and utilize appropriate innovative teaching strategies. This study therefore, discussed the following

innovative approaches to teaching as a panacea for effective teaching and learning of science subjects in Nigerian secondary schools. These are;

- i. Adjustment of students,
- ii. Student/Learner Centered Approach,
- iii. Inductive Approach,
- iv. Process Approach,
- v. Student Motivation Approach, and
- vi. Socratic Approach.

i. Adjustment of Students

The teacher has numerous works to carry out in the classroom, not just to give information to students only. The traditional stereotype of the teacher, as one who stands in front of the classroom and "tells" the children, has been at odds with views of educationists for many years now. Nwachukwu (2009) noted that if the students are not assisted they may not comprehend learning, since the main duty of the teacher is to remove obstacles from the learning process and encourage them to learn. Nwachukwu further added that if proper adjustment of the students is not made, frustration will set in, and learning will not take place. Therefore, reduction of frustration is very important for effective teaching/learning to take place. The reduction of frustration enables the students to be more interested in studying sciences. From the foregoing, it can be deduced that, for the teaching of science to be effective in the secondary schools, the teachers should involve the task of assisting the students in making worthwhile and satisfying adjustment to learning.

ii. Student/Learner Centered Approach

As the center of all learning and teaching revolve around the student/learner, it would be unwise if the teaching method fails to recognize the central position of the student/learner and hence due attention paid. In this perspective of teaching science, the student/learner is considered to be foremost and all his interests are therefore served. This type of teaching recognizes the needs, values and importance of the student/learner as the center post of all teaching. This is a new perspective in the teaching of science which is different from the old/traditional method of teaching in which the teacher was seen as the most important person in the teaching and learning process. The student/learner-centered innovative methods consists of; planed discussion, advisory

approach, panel discussion, small group discussion, seminar, debate, committee and group work, problem solving research, case study, etc (Ezeano, 2013). Several innovative teaching strategies which adopts student/learner-centered approach have been developed to bring about improvements in teaching and learning of science subjects in Nigerian schools (Samuel 2007, Neboh 2012).

The student/learner-centred strategies includes among others; the use of Analogy, Constructivism, Learning Activity Package, Concept Mapping, Cooperative Learning, Individualised Instruction, Computer-Aided Instructions, Programmed Instructions, Multimedia Instructional approach, Information and Communication Technology ICT (eg. Use of internet) approach, Science-Technology-Society (S-T-S) approach, etc.

iii. Inductive Approach to Teaching

The knowledge of the past can best be used to develop the knowledge of the future. According to Okpala (2006), the inductive method begins from specific to general, known to unknown and concrete to abstract. To study any basic concept it is wise to first study the definition and all those issues leading to it. Okpala observed that inductive method is a method of discovery. The inductive method provides an opportunity for students to discover new concepts, laws, truths and new methods of solving a particular problem or finding solutions to problems in science.

iv. Process Approach to Teaching

According to Ikeobi (1990) process approach is one of the best ways to teach science. The students are taken out to observe natural things. Thus, process approach involves active participation by all students. This makes the students feel at their best, instead of finding the lesson boring or dozing in the normal classroom setting. This method allows the students to feel, touch, see, smell and enquire into things within their environment. By this method, students have been seen to retain what they have been taught more than when they were taught using the traditional method of teaching which is generally lecture method.

v. Student Motivation Approach

Researchers are of the opinion that quality teaching is found in the school and it is being carried out by qualified teachers who can

motivate students to learn under diverse conditions. Motivation is regarded as one of the qualities of achieving good teaching and learning in schools. According to Marshall (1987), student's motivation to learn can be defined as meaningfulness value, and benefits of academic tasks to the learner regardless of whether or not they are intrinsically interesting. Nwachukwu (2009) added that students are more effective learners if they are intrinsically motivated towards learning than if they are extrinsically motivated. When students are well motivated it makes teaching/learning to be more effective. Therefore, appropriate motivational techniques should be used to arouse the interest of students towards science learning. Also, the use of appropriate disciplinary measures by teachers can motivate the students to learn. A teacher should be a good role model for the students to emulate. A keen and competent teacher is always certain of good response. He should be punctual and regular to class so as to encourage the students to learn. A teacher who is always punctual in class may through this action encourage even the most perpetual let comer to keep to time for classes. The teacher should make sure the class is well controlled otherwise teaching will be ineffective.

vi. Socratic Approach

This approach involves the use of questions to elicit the hidden idea of the students. The students are asked questions to know how far they have acquired the necessary knowledge and skills imparted to them. This questioning method or Socratic Method is a good method of testing the knowledge of the students. It also gives the students the opportunity to demonstrate what they have acquired before or how far they have mastered the imparted new knowledge. According to Okpala (2006), this method help in building sense of self expression in the students and also serves as means of giving practical experience and awareness. This method, if properly applied, has been proven to have immense advantages over the lecture method of teaching science.

Meanwhile, these innovative teaching strategies have been investigated and found to be effective in enhancing students' academic achievement in the science subjects (Springer, Stanne & Donovan 1999, Anidu & Idoko 2010, Christian & Pepple 2012, Neboh 2012, etc). These innovative methods of teaching science lay emphasis on the child's active involvement in the teaching and learning process, which is a

shift from the traditional method of teaching in which the child was purported to be “only seen and not heard” in the teaching and learning environment.

iii) **Innovative Improvisation in Science Education**

Innovative Improvisation has been defined as intuition guiding action in a spontaneous way (Crossan & Sorrenti, 1997). According to Keefe (2002), Improvisation is making the most of what you have and getting the most out of what you make. It is a conversational skill that, like other social and interactive skills, can be taught. When improvisation is used in teaching science, students provide different answers throughout the discussion and the instructor does not evaluate any given answer, instead facilitates the improvisation among the students, with the goal of guiding them toward discovery of their own knowledge. Everyone gets to express themselves creatively, to play together, to have their ideas honored and to have their mistakes forgiven. Innovations in the area of improvisation techniques, sometimes referred to as activities, exercises, or games, are tools that can be added to any existing set of science teaching strategies. It can increase students' awareness of problems and ideas fundamental to their intellectual development. Disciplined innovative improvisation provides instructors/educators with a way to conceptualize creative science teaching within curricular structures (Okoye 2012).

When innovative improvisation is reformatted into small-group collaborative learning activities in a learner-centered environment, it can be a powerful science teaching tool. Research evidence demonstrates that it can promote spontaneity, intuition, interactivity, inductive discovery, attentive listening, nonverbal communication, ad-libbing, role-playing, risk-taking, team building, creativity, and critical thinking (Crossan, 1998). These features are all about the students' learning and retention of scientific knowledge.

Panacea for Improving Students' Academic Achievement in Science Subjects

Science subjects should be presented in such a way as to give the recipients power to apply such scientific knowledge in real life situations in order to achieve success in life. Knowledge is power; hence scientific knowledge is power. Based on the foregoing, science should

be presented in such away as to enable the students to experience practical application of scientific concepts in solving everyday life activities/challenges which are within the environment. The inability to present science in a way as to enable students to experience science is one of the gaps that innovative practices are poised to fill in science education. Moreover, one of the main objectives of science education is to give the recipient power and ability to cope better with men and things, and also to become more efficient in the great struggle for existence (Onyishi, 2007). This can be achieved when the science teachers apply innovative practices in their lesson delivery.

More so, innovative practices in science education increases students' strength to grasp and utilize scientific knowledge to solve daily problems (Okpala 2006). It helps students to acquire practical ability to solve difficult problems. It may also enable the students to marshal their scientific knowledge at will and concentrate it upon a given problem in order to proffer solution to such a problem. Innovative practices in science education helps students to acquire and practice scientific knowledge in order to achieve success in life.

Meanwhile, a scientifically literate student is expected to be one who is so trained in his perceptive abilities and analytical powers. One who is so trained in all his abilities and is not overwhelmed by difficult surroundings, rather, he can master the difficult situations and come out victorious (Okoye 2012). Therefore, the important thing that should be uppermost in the minds of science educators in order to improve students' academic achievement in the science subjects should be the utilization of innovative practices in the classroom. When teachers adopt innovative practices in science education, the students' academic achievement will be greatly enhanced.

CONCLUSION

Innovative practices are tools that empower both students and teachers. By engaging in innovative practices, the learners' needs are met because it supports students' preference for learning by doing. Innovative practices are promising for instructors because they support teachers to engage students with hands-on inquiry learning. These innovative practices in science education are prominent in the areas of the science education curriculum, teaching and learning of science, and

improvisation. Currently, emphasis is being laid on hands-on activities and child centeredness of teaching and learning. The science teacher should therefore capitalize on this and make the classroom and the laboratory to be full of activities to enable the students to have first-hand knowledge of science. The science teacher should always give the students assignments on continuous bases so as to keep them busy. The use of Information and Communication Technology (ICT) by the students should also be encouraged by the teacher as part of the innovative practices. When teachers and students fully embrace innovative practices in science education, students' academic achievement will be greatly enhanced. These will bring about improved students' academic performances in science subjects.

Suggestions for Improvement

1. Science teachers should utilize innovative practices in their lesson delivery so as to enhance students' active participation in the lesson for enhanced academic performance.
2. Intensive in-service programs should be organized to get the science teachers acquainted with and trained on how to effectively utilize innovative practices in science education.
3. Science teachers should be allowed to visit schools that are utilizing innovative practices to observe new methods and materials in action.
4. Science teachers and principals should be encouraged to become more cosmopolitan in approaching teaching techniques.

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