INNOVATIVE TEACHING OF SCIENCE AT THE PRIMARY LEVEL FOR SCIENTIFIC LITERACY: A SPRINGBOARD FOR GLOBAL COMPETITIVENESS

Adanma Ngozi Ohia, Ph.D
Faculty of Education
University of Port- Harcourt, Choba,
Rivers State.

And

Kenneth Kelechi Obasi, Ph.D
Faculty of Education
University of Port- Harcourt, Choba,
Rivers State.

Abstract

It is a truism that science is of great importance. To tap into the numerous benefits of science, it is vital now than ever, to raise the science awareness of learners at their early ages to responsive research and innovation that will unlock their creative potentials. What pupils learn is influenced to a great extent by how they are taught. This study therefore x-rayed innovative strategies that can enhance inquiry-based science teaching in the classroom to pupils in government owned (public) primary schools in Rivers State. Descriptive research design was used. The sample size was 191(20%) of a population of 956 primary five teachers got by stratified random sampling technique. Data were collected using a researcher-developed questionnaire titled "Innovative Science Teaching Strategies Questionnaire" (ISTSQ). This validated instrument had a reliability index of 0.88. This study had two research questions answered using mean scores and one hypothesis tested using z-test of differences. Findings showed that the teachers still use conventional traditional methods to teach science and there is no separate laboratory space for teaching and learning science in the schools. Recommendations include that there is need to create pupil-centered science learning environment, encourage self-directed-learning in the primary schools so that pupils can acquire scientific knowledge early in life that will equip them later for global competitiveness.

Keywords*:* Innovative science teaching, primary level, pedagogic practices, scientific literacy, global competitiveness.

The world today, more than ever before, has become integrated socially with a combination of different peoples and their cultures. This has provided new vista of opportunities for learning in science education for science literacy. To this extent, science is essential both as a field of study and a body of knowledge to explain the interconnections between entities in the wake of new technologies existing in the global economy. As observed by Mcfarlene (2013), it is science that provides the needed rationale in the contexts of global collaborations and co-operations among nations and regions. The technological advancement of any nation has science as its foundation. To a great extent, the economic development of a nation is an index of her science and technological development (Odo, 2012). Science as a matter of fact "rules" the world and is a viable tool to meet global challenges.

The rapid spread of global diversification has made it pertinent to focus on inquiry-based science in the classroom starting from the primary level of education in Nigeria. Odo (2012) explained that achieving technological advancement is hinged on solving the problem of teaching science at the grassroots; stressing that there is need for science teachers to be effective in the use of laboratories to teach the pupils efficiently. This will help them grow up having the ability to apply learnt scientific concepts in everyday living and acquire scientific knowledge and also develop higher order thinking skills. There is an urgent need therefore, to reconceptualise the teaching of science towards increased development of scientific literacy among young learners. Even developed nations recognize the importance of this as some policy reports issued by the American Association for the Advancement in Science in 1993 recommended a comprehensive change in the teaching and learning of science. This can help in preparing scientifically literate manpower who can compete effectively in contemporary scientific-and technological-oriented global economy.

Kolokouri and Plakitsi (2012) carried out a study that used history of science in natural sciences from the early grades as a fruitful step towards scientific literacy and this has become a priority globally. They asserted that starting early establishes the foundation of scientific knowledge in consideration of the fact that science is a lifelong learning activity. Concluding that infants build up their foundations for developing scientific concepts as they explore their surrounding environments using their senses to satisfy their natural curiosities.

Scientific literacy is of great importance as Osokoya (2011) opined that science education is a means of producing science-enthusiastic citizens for a nation's development; stating that science education is primarily concerned with producing scientifically literate societies. It also ensures that the subject matter content is relevant in the everyday life of learners affirming that a good relationship exists between science and the society.

Present day science curricula in the nation's primary schools seem to

emphasize learning of basic facts and definitions from textbooks, de-emphasizing the application of scientific knowledge. Scholars therefore advocate a change in the present science-teaching method that is teacher-centered to an innovative student-centered learning. Scholars have observed that the conventional method of teaching science tends to suppress learners' curiosity and make them have the impression that they do not have the capability to understand science. Guzey and Roehrig (2009) quipped that science teaching is not just complex but also a dynamic activity yet science teachers find it difficult to stay-up-to-date in line with global demand.

For science education to be useful in meeting global challenges, there is need for a re-conceptualization of science teaching in the nations' primary schools. Innovative pedagogical practices like interactive sessions, practicals, seminars, laboratory-based science teaching are advocated, in addition to self-directed learning, self-paced learning and individualized instruction.

Problem of the Study

In primary schools, it seems that the teachers still use traditional conventional teaching methods to teach science from textbooks. The emphasis as a matter of fact, is on memorization with the teacher occupying the centre stage doing all the talking and carries out whatever little activity that takes place in the science class. The regimented science-learning procedure tends to eliminate the pupils' personal interests and makes them have negative perception about science.

Research Questions

The study was guided by the following research questions

1. What are the innovative pedagogical practices adopted in teaching science in government owned primary schools?
2. What innovative science teaching/learning activities go on in government owned primary schools?

Hypothesis

Ho_1: There is no significant difference between the mean responses of teacher in urban and rural primary schools on the innovative methods used in teaching science.

Methodology

Research design

The study adopted descriptive survey design by collecting data that described the existing phenomena in terms of the science teaching methods in the state government owned primary schools.

Sample and Sampling Technique

The sample size was 191 primary five teachers made up of 102 teachers and 89 teachers from urban and rural primary schools respectively. The stratified random sampling technique was used to get the sample from a total population of 956 primary five teachers.

Research Instrument

The instrument for data collection was a researcher-developed questionnaire titled "Innovative Science Teaching Strategies Questionnaire" (ISTSQ). It had two sections: section A sought to elicit demographic information about the respondents while section B had the items that provided answers for the research questions. The instrument had a total of 16 items. The response pattern was structured in line with modified Likert 4 – point scale rated in this order: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2 and Strongly Disagree (SD) = 1. The criterion mean that guided the decisions on each item is 2.5.

Validity of the Instrument

The instrument was validated by two test and measurement experts in the Faculty of Education of University of Port Harcourt. This was to establish the content validity of the instrument.

Reliability of the instrument

Test and retest method was used to establish the reliability of the instrument. The reliability index was 0.88. This shows that the questionnaire items were reliable.

Administration of Instruments

The instrument was administered by the researchers with the assistance of three research assistants in the Faculty of Education. 149 copies of the questionnaire were collected on the spot while 42 copies were returned three days later. Out of the 191 copies administered, there was 100% retrieval but 6 copies were invalid due to double ticking by the respondents.

Presentation and Discussion of Findings

Research Question 1

What pedagogical practices are adopted in teaching science in the primary schools?

Table 1: Mean scores of pedagogical practices adopted in primary schools.

S/N	Pedagogical Practices	Mean Scores
1.	Classroom teaching	2.00
2.	Collaboration among teachers	2.55
3.	Strict teacher guidance	3.11
4.	Lecture – like activity	2.75
5.	Interactive science sessions	2.20
6.	Learning guides	1.78
7.	Seminars	2.01
8.	Laboratory Practical	1.11
9.	Resource area visit	1.00

The items with mean scores below 2.50 are the pedagogical practices like interactive science sessions, use of seminars, learning guides, science laboratory practicals, that the teachers responded negatively to. They do not use them. Items 5 – 9 in Table 1 are innovative pedagogical practices though the researchers decided not to tag it as such so that the respondents will not preempt any thing that will influence their responses. On the contrary, items 1 to 4 are the conventional methods. They have mean scores above 2.50. They are the practices adopted in the teaching of

science. Item 8 in Table 1, shows that the use of laboratories has a mean score of 1.11; which means that it is not an adopted practice at all. This is contrary to the explanation of Odo (2012) that for scientific literacy, the teachers need to be effective in their laboratory practices in teaching science. To produce science-enthusiastic pupils for technological advancement to meet global challenges, Guzey and Roehrig (2009) quipped that it is essential for science to be seen as a dynamic field of study; so there is need for interactive science sessions between the teachers and the students' not just collaboration among the teachers.

Research Question 2

What innovative science teaching – learning activities go on in government owned primary schools?

Table 2: Mean scores on responses about the science teaching – learning activities adopted in primary schools

S/N	Teaching – Learning activities	Mean Scores
1.	Teacher – centred	2.62
2.	Text book – directed	3.00
3.	Memorization emphasized	2.70
4.	Pupil – centred learning	2.00
5.	Pupil – paced learning	1.60
6.	Individualized instruction	1.15
7.	Pupil self-discovery	2.00

In Table 2, items 1 – 3 have mean scores above the criterion mean of 2.50 which shows that the teaching of science in the primary schools is still done in the contemporary traditional way. The teacher takes the centre stage, does all the talking based on the text book content and the pupils are expected to memorize as evidence that learning has taken place. In this case, the observation of Guzey and Roehrig (20009) is correct that teachers do not perceive that science is dynamic so its teaching should not be static. Instead what is common even from the result of this study as shown in Table 2 is that the learning activities are not learner-centred allowing for pupils self – discovery. But Kolokouri and Plakitsi (2012) observed that pupils at their early ages develop scientific concepts exploring their surrounding environment.

Analysis of Hypothesis

$H_{01:}$ there is no significant difference between the mean responses of teachers in urban and rural schools on the innovative methods used in teaching science in their schools.

Table 3: z-test of difference between the mean responses of teachers on the innovative science methods used $p \geq 0.05$

Location	N	SD	Mean	df	z-critical	z - cal	Decision
Urban Rural	102 89	13.21 10.9	102.4 94.63	189	±1.96	0.82	Not significant

In table 3, the results show that the calculated z- value (0.82) is less than the critical z-value of ±1.96. Therefore the null hypothesis is retained. No significant differe nce exists between the mean opinions of teachers in the urban and the rural schools with regards to the use of

innovative methods in teaching their pupils science.

Conclusion

The teaching of science in government owned primary schools is still done in the conventional traditional teacher-centred, textbook - focused manner. Of course, there are no laboratories for science teaching and learning activities in these schools. Ability of the pupils to memorize whatever is taught is seen as evidence of learning.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. The primary school teachers should be prepared to change from making science teaching a teacher-centered activity to making the learning environment pupil-centered.
2. Government should set up science laboratories in the primary schools with trained science teachers and paraprofessionals as laboratory attendants.
3. The schools should encourage individualized pupil learning and allow the pupils to learn at their own pace.

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