
CHEMISTRY CURRICULUM INNOVATION FOR TEACHING CLIMATE CHANGE IN SENIOR SECONDARY SCHOOLS IN NIGERIA

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Abstract

The study investigated curriculum innovation for teaching climate change in senior secondary school chemistry. Descriptive survey design was used. The study area was Uyo Local Government Area of Akwa Ibom State. The population for the study comprised 781 chemistry teachers in Uyo Local Government Area. A total of 102 chemistry teachers selected using proportionate sampling technique participated in the study. Cronbach alpha reliability coefficient yielded .80. Mean (\bar{X}) and Standard Deviation (SD) were used to analyse the data collected. The study revealed that innovation was not in place for teaching climate change in senior secondary chemistry curriculum. Chemistry teachers are not trained on skills for innovation to teach climate change and innovative instructional packages are not developed in the chemistry curriculum for teaching climate change. Based on these findings, it was recommended amongst others that curriculum planners should involve chemistry teachers in the innovation of the chemistry curriculum to integrate values into learners for adequate knowledge of climate change.

Over the years, new developments have taken place in chemistry and educational systems have curriculum development as their core component with elaborate contents that students are to encounter, study, carry out activities on and gain mastery of after a period of time. Mkpa and Izuagba (2006) defined curriculum as the planned and guided learning experiences and intended learning outcomes, formulated through the systematic reconstruction of knowledge and experiences under the auspices of the school for the learners continuous and willful growth and competence. It is also the means through which educational goals, objectives, specific approaches, aims and emerging issues will be used to creatively incorporate identified needs of school learning contents. These contents could be experiences from industries, meteorological forecast stations, research institutes to maximize students experiential learning.

Mkpa and Izuagba (2006) addressed the changing conception of curriculum in reflecting new needs as problems emerge, students change in perception on a particular

issue and make distinction on the role of schools. This definition may therefore, be used to evolve innovative skills and ideas which chemistry teachers need to build upon to teach climate change. Innovating the chemistry curriculum therefore, is necessary for meaningful and effective teaching of climate change as this would bridge the knowledge gap existing in the chemistry curriculum.

The educational system is growing and innovations initiated globally makes it imperative for chemistry curriculum to be modified to meet present challenges (Ilogu, 2012). The chemistry curriculum should provide a new set of knowledge, skills and behaviours to make the practice of chemistry relevant to its learners and to include the teaching of climate change. Adikwu (2008) posits that a broad view of STM will give the curriculum relevance. This is necessary and appropriate for teaching climate change in the face of threatening weather challenges.

Climate change is a significant and lasting change in the statistical distribution of weather patterns over a long period of time ranging from decades to millions of years (Wikipedia, 2012). Factors that cause climate change include oceanic processes such as quakes, floods and land tremors with tsunamis; variations in solar radiation received by the earth in the form of extreme heat or cold, volcanic eruptions and human induced alterations of natural systems. Coral reefs collapse, typhoons, landslides and mudslides, sea-beaches and riverine areas submerging are occurring disasters in the face of climate change. The environment in which food and energy are derived is heavily burdened and threatened by the challenge climate change poses. Atmospheric pollution, ozone layer depletion, increasing concentrations of carbon-dioxide gas, methane, chlorofluorocarbons and nitrous oxides are the resultant effects of global warming. Man's increased activities through over-exploitation of natural resources such as the deforestation of the Amazon forests and water basins in Brazil, sea-dredging and irrigation in Nigeria are processes that are speedily degrading the quality of the global environment. Temperatures and humidity changes in tropical climates have led to chain casualties on communities and there is growing concern of threat from fossil combustion, nuclear plants, refineries and quarries affecting land for animal grazing and human habitation.

Chemistry is life science and requires a curriculum that is effective and lasting (Moses, 2007). Curriculum innovation plays a significant role in advancing science and technology development for a nation's self-reliance. A major reason for innovating the chemistry curriculum is to introduce modern scientific concepts derived from current scientific discoveries. An innovative approach to teaching climate change will involve a step-by-step process use of innovative instructional packages that will build up students' knowledge to see climate change as a challenge they need to tackle. Chemistry, being a practical subject, should be taught innovatively for real life

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applications. This will not only make learners acquire basic knowledge, skills and competence in the subject, but will enable teachers apply skills in teaching for solving real life problems. Developing an innovative chemistry curriculum that incorporates climate change is a herculean and engaging task that needs quality delivery and strict adherence to innovative use of available resources. It should take into consideration design and techniques for achieving well-grounded experiences in learning outcomes.

A curriculum innovation with experiential learning that will involve students to learn by doing and projecting schooling beyond participant observation is necessary to provide the needed skills to manage and sustain the environment from threats of climate change. As Olugbamila (2012) posits, the curriculum should be designed to make secondary school leavers self-reliant upon graduation.

The revised senior chemistry curriculum have themes such as chemistry and environment, chemistry of life and chemistry and industry. These themes do not include climate change and environmental management. Climate change inclusion in chemistry curriculum would stimulate students' understanding of the concept and help in finding ways to reduce its impact on the environment. Innovating the chemistry curriculum would require stakeholders such as industrialists, global communication service providers, multinational oil companies, research and educational institutions to brainstorm on ways of managing climate change challenges. These stakeholders will contribute knowledge to evolve ways and strategies that could be integrated into the chemistry curriculum to cater for the needs of students on awareness and impact on managing the environment from threats that climate change pose. It is therefore imperative for chemistry curriculum that articulates climate change challenges to be in place.

Many challenges face the development of an innovative chemistry curriculum. One of the major challenges is the teachers' lack of competence on creativity. As determinants of effective curriculum innovation; teachers need adequate knowledge and skills for innovation and where these skills are lacking, learning is hampered. Most teachers lack experience and ingenuity in developing innovative models and devices to teach chemistry and as such they are unable to innovate chemistry concepts on climate change. These teachers see the current chemistry curriculum combination as difficult with no innovative strategies as they have to keep going back to check it out for clarity. This greatly hampers knowledge acquisition of learners on classroom application of climate change. This problem could be taken care of if teachers are given opportunities to make necessary inputs into the chemistry curriculum for teaching climate change as they are the classroom implementers of the curriculum.

The National Policy on Education (FGN, 2004) on teacher education stipulates among others; producing highly motivated conscientious and efficient classroom

teachers for all levels of the educational system; encouraging the spirit of enquiry and creativity in teachers; providing teachers with the intellectual and professional background adequate for their assignment and making them adaptable to changing world situations. Teacher education therefore should equip chemistry teachers with the knowledge of innovation on climate change. Students are a part of the society where climate change is occurring and chemistry teaching requires creative and productive teachers with professional competences on innovation to meet the challenges that climate change is posing. Maduwesi and Ezeocha (2010) noted that prescribing the National Education Certificate as qualifications for teaching at the basic foundation level without restructuring the curriculum on teacher education introduces some weaknesses into teacher quality at that level. There is need therefore, for quality staff with the right caliber of knowledge and skills needed to bring innovation into the chemistry curriculum to enhance knowledge-acquisition on climate change for its learners. This will properly position chemistry students to seek for knowledge on their own and be ready to embrace innovative skills on challenging social issues like climate change.

Innovative instructional packages are very useful tools for chemistry teaching on climate change. Illustrative instructional packages such as models, realia, phenomenals, flip-charts, manipulable and simulated picture environment, pictorials, film slides, tours to flooded sites, beaches with coral reefs, fjords, marine estuaries, desertification and iconic symbols will stimulate students' interest towards learning. These innovative packages will enable the teacher bring relevance on teaching that will initiate and impact students' knowledge of climate change. Training and retraining of teachers on innovation will bring about quality teaching and resourcefulness on lesson outcomes. Obilo and Akuakanwa (2012) posited that teacher preparation and use of instructional materials, classroom management and planning techniques are necessary strategies for teachers to adapt to innovation. Olorundare (2006) suggested that courses like chemistry need trained teachers with skills and ingenuity to tackle the problem of unavailability of materials, equipment and other modern instructional materials. A qualified teacher of chemistry knows what to provide, how to provide, when to use the materials and should endeavour to innovate materials for teaching students. This will help to evolve effective teaching themes on climate change and enhance productivity towards quality teaching of the concept in chemistry. Curriculum innovation that creates awareness and improves learners knowledge-acquisition will bring about a change in learners' attitude towards climate change. Innovation therefore, should evolve lasting changes that will lead to skills empowerment for students' active participation in solving climate change environmental problems. Hence, there is need for learners to develop positive environmental attitudes that will help maintain dynamic balance between quality of life and the quality of the environment.

Statement of the Problem

Many challenges face the innovation of chemistry curriculum. The dearth of quality teachers with skills and competence to innovate the chemistry curriculum is hampering innovation of chemistry concepts on climate change. Teachers are not trained on innovation techniques and teaching strategies that can solve impending weather threats. Most teachers do not have adequate knowledge and competence on teaching concepts to combat the challenges of climate change. The 2009 revised senior secondary school curriculum is ineffective for innovation to manage and handle the teaching of climate change. The chemistry curriculum lacks concepts on climate change that pose phenomenal challenges to chemistry students who face weather-change patterns without adequate knowledge. Innovation on the chemistry curriculum will therefore prepare students to face climate change positively.

Research Questions

This study was designed to investigate chemistry curriculum innovation for teaching climate change in senior secondary schools in Nigeria. Specifically, it was designed to achieve the following objectives:

1. To what extent is innovation in place to facilitate the teaching of climate change in chemistry curriculum?
2. To what extent have chemistry teachers been trained on the use of innovative instructional packages?
3. To what extent are innovative instructional packages developed for teaching climate change in chemistry curriculum?

Methodology

The study adopted a survey research design that involved the responses of chemistry teachers. The study area was Uyo Local Government Area of Akwa Ibom State. The population of the study was all the 781 chemistry teachers in senior secondary schools. Proportionate sampling technique was used to select a sample size of 102 chemistry teachers from all the arms of senior secondary schools. Chemistry Curriculum Innovation for Teachers' Questionnaire structured on a 4-point rating scale of Strongly agree (4 points), Agree (3 points), Disagree (2 points) and Strongly Disagree (1 point) was the instrument used to collect data for the study. Face validation of the instrument was carried out by two lecturers on Curriculum studies and a lecturer in Educational measurement and Evaluation in the University of Uyo, Uyo. Cronbach alpha reliability coefficient yielded .80. Mean (X) and Standard Deviation (SD) were used to analyse the data collected. Any mean score below the criterion mean of 2.50 was not accepted but a mean of 2.50 and above was accepted. Results of the study are presented below:

Research Questions 1

1. To what extent is innovation in place to facilitate the teaching of climate change in chemistry curriculum?

Table 1: Mean Ratings of Responses of Chemistry Teachers on Curriculum Innovation on Climate Change

S/N	Item Statement	\bar{X}	SD	Remark
1	Sensitization	3.46	0.53	A
2	News effect	3.72	1.01	SA
3	Advertisements	2.84	1.04	A
4	New technologies utilization	3.52	0.71	A
5	Billboard bulletins on degradation activities	2.93	1.79	A
6	Creating new ideas	3.64	0.63	A
7	Creating iconic models	2.87	1.04	A
8	Adopting models	3.40	0.74	A
9	Iconic symbols on climate change	3.42	0.75	A

Data in Table 1 showed that chemistry teachers had high mean ratings on all the items. It is their opinion that innovation needs of teachers should include: sensitization on the need for innovation of the chemistry curriculum to enable them teach the learners challenges climate change pose such as giving news on climate change from radio, television and newspaper reports during lessons, using advertisements on weather challenges to create awareness on students. This includes using billboard advertisement, new technologies, creating new ideas for self-initiatives that will promote learning on climate change; adopting existing models and introducing iconic symbols to stimulate students' interest on the effect of climate change.

Research Questions 2

2. To what extent have chemistry teachers been trained on the use of innovative instructional packages?

Table 2: Mean Ratings of Chemistry Teachers Responses on Innovative Training Skills for Climate Change

S/N	Item Statement	\bar{X}	SD	Remark
10	Industrial exposure	2.61	0.66	A
11	Meteorological forecast	3.01	0.49	A
12	Green ecology movement	3.60	0.57	A
13	Local farmers use	3.06	1.34	A
14	Practical activities	3.84	0.82	A

Data in Table 2 showed that all items are highly rated by the participants. It is their opinion that teachers should be adequately trained on innovative skills for effective content delivery on climate change. These should include; industrial exposure for concrete handling of equipment and apparatus for climate change teaching; acquiring skills from meteorological stations on weather forecasting, studying objectives on green ecology bulletins; using local farmers knowledge on environmental factors to initiate practical activities related to climate change.

Research Questions 3

3. To what extent are innovative instructional packages developed for teaching climate change in chemistry curriculum?

Table 3: Mean Ratings of Chemistry Teachers Responses on Innovative Instructional Packages for Climate Change

S/N	Item Statement	\bar{X}	SD	Remark
15	Excursion/posters on climate change	3.56	0.51	A
16	Pictorial landscapes on climate change patterns	3.04	1.47	A
17	Ecological devastations on local environment	3.91	1.25	A
18	Erosion degradation site tours	2.76	0.63	A
19	Films/slides	3.73	1.02	A
20	Realia/phenomenals	3.12	0.86	A

Data in Table 3 indicated that all items have high mean ratings. It is teachers' opinion that innovative instructional packages be developed for the chemistry curriculum and these should include; excursions and use of posters on climate change for effective inculcation of learning; pictorial landscapes embossed on charts, trips to ecological devastation sites and erosion sites in the local environment; films/slides for highlighting scenes on deforestation and desert encroachment, realia and phenomenals are also needed as instructional packages for information dissemination.

Discussion of Findings

The findings of this study revealed that innovations that will improve and enhance classroom instruction for actualizing the teaching of climate change by chemistry teachers is not in place. This is in agreement with Adikwu (2008) who opined that the curriculum should provide a set of knowledge, skills and behaviours that encompass a broad overview of the practice of science, technology and mathematics including chemistry to make the learner become relevant. Innovation in the chemistry curriculum is urgently needed to be in place to provide relevant learning experiences needed by chemistry teachers for learners environmental awareness on climate change. Findings in Table 2 indicated that chemistry teachers do not possess: relevant skills for

innovative chemistry teaching to facilitate learners' knowledge on climate change. This corroborates the findings of Obilo and Akuakanwa (2012) which stated that teacher education should equip chemistry teachers with modern and innovative knowledge, for teaching strategies that will help learners cope with societal challenges such as climate change. Teachers need to possess all the skills indicated to equip students learning. This will improve the quality of teaching climate change in an innovative chemistry curriculum. Findings in Table 3 revealed that there are no innovative teaching instructional packages on climate change in the chemistry curriculum. Urgent intervention is therefore needed for dynamic, value-laden teaching to enable chemistry teachers face challenges associated with climate change. This finding is in agreement with Olorundare (2006) that corroborated the fact that teachers need training on skills and ingenuity to know what to provide, how to provide and when to use instructional packages to accelerate teaching proficiency and productivity. These will appeal to the interest of young learners and attract attention to creative ways of promoting and evolving knowledge on managing the environment for future generations.

Conclusion

Innovations in achieving educational objectives of the National Policy on Education to enhance environmental protection and sustainability is a priority to meeting the challenges that climate change pose. Developing and implementing an innovative chemistry curriculum will provide teachers the opportunities to train on skills, instructional material development and give learners the experience on hands-on and do-it-yourself activities for effective environmental management and sustainability on climate change.

The chemistry curriculum therefore should evolve new creative ideas for innovation to cover skills, knowledge, standards and competencies that will help the teacher make informed decisions on how learners should be taught climate change challenges.

Recommendations

1. The media should promote campaigns that focus on cleaner green environments for environmental protection.
2. The Federal government should set up agencies within communities that will discourage the logging and felling of forest trees.
3. Tree planting should be made compulsory in all communities in Nigeria.
4. The school administration should encourage aesthetic environment with planting of trees on school sidewalks.
5. Taskforce on environment should be created to enforce regulatory policies on environmental management in communities, institutions and companies.
6. Filled drains should be cleared regularly to avoid accumulation of debris and wastes.

7. Students should form environmental awareness clubs on climate change on campuses to sensitize other students.
8. Green clubs for managing the immediate environment should be established in secondary and primary schools.

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