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CHEMISTRY TEACHERS' PERCEIVED RELEVANCE OF THE SENIOR SECONDARY SCHOOL CHEMISTRY CURRICULUM CONTENTS TO MEETING THE CHALLENGE OF CLIMATE CHANGE CONTROL

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Abstract

A major way of combating climate change and the inherent adverse effects is to control human Chemical activities which cause hazard emissions into the atmosphere. The chemical activities might be better understood and controlled through Chemistry education. Thus, this study investigated Chemistry Teachers' Perceived Relevance of the Senior Secondary School Chemistry Curriculum Contents to Meeting the Challenge of Climate Change Control. The study was conducted using two hundred and sixty Chemistry teachers in Ebonyi state, South-East of Nigeria. The study adopted a survey research design. Two research questions and one hypothesis guided the study. One hundred and twenty Chemistry teachers randomly sampled from public secondary schools in three education zones of the state were used for the study. A validated, structured questionnaire developed by the researcher captioned Chemistry Teachers' Perceived Relevance of Chemistry Curriculum Contents to Meeting the Challenge of Climate Change control Questionnaire was used to collect data for the study. The questionnaire has reliability index of 0.78 as determined using Cronbach Alpha method of determining internal consistency of a test. The mean score and standard deviation were used to answer the research questions while t-test was used to test the hypothesis at 0.05 level of significance. The study revealed that Chemistry curriculum contents are perceived relevant to climate change control by Chemistry teachers. Again gender has significant influence on Chemistry teachers' perception of relevance of Chemistry Curriculum Contents to Meeting the Challenge of Climate Change control. Recommendations made based on the findings of the study include: Adequate attention should be paid by school proprietors on training and retraining of Chemistry teachers on effective strategies of making Chemistry instruction relevant to the learner; Chemistry curriculum should be reviewed regularly by curriculum planners to ensure its suitability/relevant to current societal need and aspiration such as climate change control.

Keywords

Chemistry, Curriculum Contents, Climate Change

Introduction

Climate is the average weather conditions of a place over a given long period of time, usually thirty years. The anthropological importance of climate cannot be over-emphasized. According to Martin & Mahaffy (2013) the climate determines the types of vegetation and animal species found in a given ecosystem. This implies that climatic condition determines the distribution and survival of plants and animals on different parts of the earth surface. The elements of weather/climate whose average statistical records determine the climate of a place include temperature, precipitation, humidity, wind, cloud and atmospheric pressure. The amount of the elements of weather vary over a period of time hence, average records of the elements are used to determine the climate of a given geographical area.

Since the amount of the elements of climate can vary, it means that climatic condition of a give place/region can as well change. Egbeama (2015,p 96) refers climate change as 'remarkable and significant changes in the normal conditions of the earth's atmosphere observed over a long period of time'. Climate is changed by significant alteration of

composition of the elements of weather/climate as observed over a long period of time. Basically two factors are responsible for Climate change. These factors are natural or physical factor and human factor (Martin & Mahaffy, 2013). The physical factor includes change in solar radiation, volcanic eruption and astronomical factors. The human factor could be inadvertent or advertent activities of the human being. These include replacing forest, building of damn in the river, draining of swamps, irrigation of arid areas, release of energy into the atmosphere, changes in composition of the atmosphere through emissions, artificial generation or reduction of rain, wind breakers and shelter belts (Agulue, 2015).

Climate change has great historical and economic importance in adaptation, evolution and extinction of living things or total distortion of the ecosystem. The consequences of climate change are alarming. The consequences include global warming, alteration in precipitation patterns, flooding, desertification, extinction of different species of living things and increase in the range and varieties of disease vectors (Egbeama, 2015). There are both human and animal migrations and overall adverse effects on global socio-economy statue due to climate change. According to Yakob, Ismail & Razak (2012) climate change is the ultimate weapon for environmental destruction. They also added that the main cause of climate change is human activities that are not environmentally friendly. Such activities evolve chemical by-products that could interact with the environment and cause harm to the environment. In Nigeria and some other African countries for instance, the effects of climate change on the environment are alarming (Adigun, 2017). This is as observed in unusual perennial flooding across and breath the nation, desert encroachment, gully erosion death traps, land slide, unusual long periods of hot atmosphere, abnormal rise in tides, poor agricultural yields, extinction of some plants and animal species (Agulue, 2015). The hazardous nature of climate change to the environment calls for a serious global intervention.

Consequently, one of the major goals of the United Nations 2030 agenda for global Sustainable Development Goals (SDGs) is 'climate action'. This calls for taking urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy (Okeke, 2017). Thus climate change control becomes a global scientific, economic and political issue.

A major way of combating climate change and the inherent adverse effects is to control human activities which cause emissions into the atmosphere (Feierabend, Jokmin & Eiks, 2011). Some of the emissions include carbon(iv)oxide, methane, sulphur(iv)oxide, nitrogen oxides, volatile organic compounds (VOC), chlorofluorocarbons and heath energy. These emissions are mainly generated through chemical activities (Achugbu, 2015). The chemical activities might be better understood and controlled through Chemistry education.

Chemistry is a science subject that studies interactions of matter from the particulate level and the energy consequences (Igboanugo, 2013). Thus, Chemistry is a science of details about matter. Through effective material interactions, Chemistry produces valuable materials such as medicine, cosmetics, paint, food products, and nanotechnologies to mention but a few. However, fallouts which could have negative effects on the environment might accompany production of the valuable products. Suffice it to say that Chemistry is directly involved in human activities which could always generate not only valuable products but fallouts from material interactions capable of changing the climate (Yakob, Ismail & Razak, 2012). These human activities could be at domestic or industrial level. Conversely, through Chemistry knowledge, such ills as environmental pollution and food poisoning which are fallouts from material interactions are controlled (Ikokwu & Eke, 2017). Chemistry therefore does not only strive to utilize the natural resources and create new ones for the betterment of the society but also strives to control negative chemical interactions in the environment (Igbaonugo, 2018).

Again, green Chemistry has been introduced by educators as an alternative to Education for Sustainable Development (ESD) as declared by the United Nation from year 2005 to 2014. Green Chemistry is the practice of Chemistry in a manner that maximizes its benefits while eliminating or at least greatly reducing its adverse impacts (Manahan, 2006). Green Chemistry has a potential to solving environmental problems such as climate change control. Thus climate change control is a critical

issue to be discussed in Chemistry education since the causes of climate change are related to the questions of Chemistry and has consequences for other economic and social issues (Feierabend, Jokmin & Eiks, 2011).

Climate change control refers to the way the adverse change in climate should be regulated for effective protection of the ecosystem. An aspect of the 2015 Paris Agreement is the use of education, training, public awareness, public participation and public access to information to control climate change.

Climate change Control through Chemistry education is needed to ensure a sustainable development which might be possible through proper structuring of the Chemistry curriculum (Yakob, Ismail & Razak, 2012). This idea is in agreement with the Nigerian Chemistry curriculum which maintains that the curriculum has been structured to cater for the needs and aspirations of Nigerians in line with the contemporary global issues (FME, 2007). Such contemporary issues addressed by the curriculum might include the global call for climate change control.

Educationists like Esu (2007) and Oforma (2009) see curriculum as all the learning experiences which are planned or guided by the school whether carried out in groups or individually either in school or outside the school. Chemistry curriculum is thus a document which stipulates among other things the content, teacher's activity, students' activity, expected outcomes within a given stage of teaching and learning process in Chemistry. The Chemistry curriculum aims at development of the learner for useful living in the society (FRN, 2013).

The Chemistry curriculum therefore becomes the blue print for the realization of the societal aspirations and needs (Igboanugo, 2018). As a reference material, if the curriculum is faulty, the aspirations of the nation and the aims of education system are likely to be forfeited. Consequently, researchers such as Egolum & Igboegwu (2012); Moses (2012) and Martin & Mahaffy (2013) have stressed the need for constant evaluation and restructuring of Chemistry curriculum to ensure its suitability for sustainable development.

The curriculum delivery is the major responsibility of the teacher (Adigun, 2017).The Chemistry teachers' responsibility of curriculum delivery can be influenced by such factors as gender, mode of instruction and experience (Igboanugo, 2019). Gender which is the state of being male or female has been inconclusively reported by host of researchers about its effects on Chemistry teachers' influence on curriculum delivery (Okorie & Eze, 2016; Egolum & Igboanugo, 2017; Igboanugo, 2018). Thus considering the importance of Chemistry curriculum in overcoming personal and societal challenges such as the climate change control, the pertinent questions that needed answers might be: To what extent has the Chemistry curriculum addressed the climate change control? What are the Chemistry teachers' opinions about the relevance of Chemistry curriculum contents? Do male Chemistry teachers' opinions differ from female Chemistry teachers' opinions about the relevance of Chemistry curriculum contents?

Problem of the Study

One of the objectives of the Chemistry curriculum in Nigeria is to provide students with the basic knowledge in chemical concepts and principles through efficient selection of contents and sequencing. In line with this objective, the curriculum planners went further to assert that curriculum has been structured to cater for the needs and aspirations of Nigerians in line with the contemporary global issues. Climate change control is one of the contemporary global/national issues in Nigeria that is expected to be catered for by the Chemistry curriculum. However, the present unbridled releasing of emissions through human activities that cause green house effects and other problems due to climate change might raise a question mark about the relevance of chemistry curriculum content for climate change control. Thus, it might be pertinent to determine the relevance of the Chemistry curriculum contents in meeting the challenge of climate change control. This informed the problem of this study as follows: what is the Chemistry teachers' perceived relevance of senior secondary school Chemistry curriculum contents to meeting the challenge of climate change control?

Purpose of the Study

The purpose of this study was to determine chemistry teachers' perceived relevance of the senior secondary school chemistry curriculum contents to meeting the challenge of climate change control. In specific terms the study set out to determine:

1. The relevance of the contents of Chemistry curriculum to climate change control as perceived by Chemistry teachers
2. The influence of gender on chemistry teachers' perception of the relevance of chemistry curriculum contents to meeting the challenge of climate change control.

Research Questions

The following research questions guided the study:

1. To what extent do Chemistry teachers perceive Chemistry curriculum Contents relevant to climate change control?
2. To what extent does gender influence Chemistry teachers' perception of the relevance of Chemistry curriculum Contents to climate change control?

Hypothesis

HO_1. There is no significant difference in the mean rating scores of male and female Chemistry teachers on the relevance of Chemistry curriculum contents to climate change control ($p<0.05$)

Methodology

The study adopted the survey research design. The area of the study was Ebonyi State, South-East of Nigeria. Population of the study comprised all the two hundred and sixty (260) Chemistry teachers in the public Senior Secondary schools in the three Education zones of the State (SEB, 2019). The teachers were stratified into the education zones of Abakaliki, Afikpo and Onueke. Simple random sampling technique was used to select forty Chemistry teachers from each of the strata to get one hundred and twenty (120) Chemistry teachers (60 male teachers and 60 female teachers) used in the study.

Instrument for Data collection

The instrument used to gather data for the study was a self-structured questionnaire. The instrument was captioned Chemistry Teachers' Perceived Relevance of Chemistry Curriculum Contents to Meeting the Challenge of Climate Change Control. The questionnaire had part A and part B. Part A sought for the personal data of the respondents while part B comprised 42 items from the contents of Chemistry curriculum which was organized by the researcher from SS1, SS2 and SS3 sections of the curriculum. The respondents were expected to rate these items in terms of their relevance to climate change control. In Part B, the questionnaire was of four-point scale. There were four options of Very Relevant (VR) = 4, Relevant (R) = 3, Somehow Relevant (SR) = 2 and Not Relevant (NR) = 1. The instrument was face and construct validated by two experts in Chemistry education, one expert in Measurement and Evaluation and a secondary school Chemistry teacher. Their contributions helped to ensure that each of the test items was understandable and relevant to the study. The questionnaire was trial tested on 30 teachers from secondary schools in Anambra State which is outside the area of study. The trial test helped to improve the quality of the test items and confirm the face validity of the items. Again from the result of the trial test, reliability index of the instrument was determined to be 0.78 using Cronbach Alpha method of determining internal consistency of a test.

The instrument was administered by the researcher with the assistance of the school principals and head teachers. All the administered questionnaires were retrieved. The data collected using the questionnaire were analyzed using spss version 22.0 and used to answer the research questions and test the hypothesis for the study. The research questions were answered using mean and standard deviation. The criterion mean rating value was 2.50. Items with mean rating value 2.50 and above indicated relevant while items with mean rating value below 2.50 indicated not relevant. The hypothesis was tested using the t-test at 0.05 value of significance.

Results

The results of the study are presented in tables 1, 2 and 3.

Research Question 1:

To what extent do Chemistry teachers perceive Chemistry curriculum Contents relevant to climate change control?

Table 1: Mean ($\dot{X}$) and Standard Deviation (SD) Ratings of Teachers' on Relevance of Chemistry Curriculum Contents to Climate Change.

Content	Teachers n= 120		
	Ẋ	SD	Decision
Introduction to Chemistry	3.50	0.871	Relevant
Chemical Industries	3.67	0.959	Relevant
Adverse effects of Chemicals	3.75	0.496	Relevant
Particulate Nature of Matter	3.09	0.485	Relevant
Physical and Chemical changes	3.67	0.637	Relevant
Mixtures and Compounds	3.07	0.676	Relevant
Symbols, Formulae and Equations	2. 71	0.646	Relevant
Chemical Combination	3.17	0.906	Relevant
Gas Laws	3.65	0.654	Relevant
Separation Techniques	2. 99	0.637	Relevant
Acids, Bases and Salts	3. 17	0.956	Relevant
Water	2.83	0.906	Relevant
Carbon and Its Compounds	3.50	0.624	Relevant
Coal	3.17	0.906	Relevant
Crude Oil/ Natural Gas	3.67	0.769	Relevant
Hydrocarbons	3.46	1.022	Relevant
The Periodic Table	2.68	1.080	Relevant
Chemical Reactions	3.27	0.660	Relevant
Chemical Equilibrium	2.94	0.916	Relevant
Mass Volume Relationships	2. 58	0.679	Relevant
Acid Base Reactions	2. 84	0.611	Relevant
Solubility	2.77	0.622	Relevant
Air	3.67	0.627	Relevant
Hydrogen	3.00	0.576	Relevant
Oxygen	3. 33	0.583	Relevant
Halogens	2.83	0.608	Relevant
Nitrogen	3.14	0.624	Relevant
Sulphur	2.92	0.616	Relevant
Redox Reaction	2.91	0.605	Relevant
Electrochemical Series	2.80	0.532	Relevant
Electrolysis	2.83	0.122	Relevant
Alkanols	2. 83	0.334	Relevant
Polyhydroxy Compounds	3.33	0.684	Relevant
Fermentation	3.20	0.712	Relevant
Titrations	2.97	0.511	Relevant
Qualitative Analysis	3.17	0.623	Relevant
Petrochemicals	3.76	0.301	Relevant
Metals and Compounds	2.94	0.901	Relevant
Chemical wastes and Industrial Pollutants	3.76	0.321	Relevant
Fats and Oil	2.64	0.992	Relevant
Soap and Detergent	2. 67	0.731	Relevant
Giant Molecules	2.84	0.663	Relevant

Acceptable mean value rating = 2.50 and above.

Results in Table 1 show that all the Chemistry curriculum contents were perceived relevant to climate change control by Chemistry teachers.

Research Question 2:

To what extent does gender influence Chemistry teachers' perception of the relevance of Chemistry curriculum Contents to climate change control?

Table 2: Mean ($\dot{X}$) and Standard Deviation (SD) Ratings of Male and Female Teachers' on Relevance of Chemistry Curriculum Contents to Climate Change.

Content	Male n= 60			Female n= 60		
	$\dot{X}$	SD	Decision	$\dot{X}$	SD	Decision
Introduction to Chemistry	3.67	0.461	Relevant	3.33	0.336	Relevant
Chemical Industries	3.67	0.303	Relevant	3.67	0.460	Relevant
Adverse effects of Chemicals	3.67	0.451	Relevant	3.83	0.321	Relevant
Particulate Nature of Matter	3.17	0.670	Relevant	3.00	0.292	Relevant
Physical and Chemical changes	3.67	0.506	Relevant	3.33	0.312	Relevant
Mixtures and Compounds	3.80	0.365	Relevant	2.33	0.358	Not relevant
Symbols, Formulae and Equations	3.75	0.459	Relevant	1.67	0.437	Not relevant
Chemical Combination	3.67	0.333	Relevant	3.00	0.365	Relevant
Gas Laws	3.80	0.423	Relevant	2.33	0.236	Not relevant
Separation Techniques	3.65	0.364	Relevant	2.33	0.306	Not relevant
Acids, Bases and Salts	3.67	0.467	Relevant	2.33	0.381	Not relevant
Water	3.67	0.501	Relevant	2.00	0.660	Not relevant
Carbon and Its Compounds	3.67	0.468	Relevant	3.33	0.299	Relevant
Coal	3.67	0.403	Relevant	2.00	0.509	Not relevant
Crude Oil/ Natural Gas	3.67	0.392	Relevant	3.67	0.329	Relevant
Hydrocarbons	3.60	0.309	Relevant	3.33	0.440	Relevant
The Periodic Table	3.68	0.409	Relevant	1.67	0.419	Not relevant
Chemical Reactions	3.20	0.500	Relevant	3.33	0.370	Relevant
Chemical Equilibrium	3.55	0.296	Relevant	2.33	0.333	Not relevant
Mass Volume Relationships	3.50	0.487	Relevant	1.67	0.543	Not relevant
Acid Base Reactions	3.00	0.556	Relevant	2.67	0.298	Relevant
Solubility	3.20	0.413	Relevant	2.33	0.506	Not Relevant
Air	3.67	0.357	Relevant	3.33	0.397	Relevant
Hydrogen	3.67	0.600	Relevant	2.33	0.119	Not relevant
Oxygen	3.67	0.398	Relevant	3.00	0.365	Relevant
Halogens	3.67	0.339	Relevant	2.00	0.467	Not Relevant
Nitrogen	3.60	0.485	Relevant	2.67	0.510	Relevant
Sulphur	3.50	0.298	Relevant	2.33	0.432	Not relevant
Redox Reaction	3.15	0.419	Relevant	2.67	0.167	Relevant
Electrochemical Series	3.60	0.401	Relevant	2.00	0.468	Not relevant
Electrolysis	3.67	0.337	Relevant	1.67	0.361	Not relevant
Alkanols	3.67	0.299	Relevant	2.00	0.457	Not Relevant
Polyhydroxy Compounds	3.67	0.506	Relevant	3.00	0.329	Relevant
Fermentation	3.40	0.309	Relevant	3.00	0.297	Relevant
Titrations	3.78	0.471	Relevant	2.00	0.400	Not Relevant
Qualitative Analysis	3.67	0.397	Relevant	2.33	0.417	Not Relevant
Petrochemicals	3.85	0.511	Relevant	3.67	0.309	Relevant
Metals and Compounds	3.55	0.404	Relevant	2.33	0.481	Not Relevant
Chemical wastes and Industrial Pollutants	3.85	0.107	Relevant	3.67	0.392	Relevant
Fats and Oil	3.60	0.409	Relevant	1.67	0.299	Not Relevant
Soap and Detergent	3.00	0.366	Relevant	2.33	0.189	Not Relevant
Giant Molecules	3.67	0.310	Relevant	2.00	0.431	Not Relevant

Acceptable mean value rating = 2.50 and above.

Results in Table 2 show how male and female Chemistry teachers perceived the relevance of Chemistry curriculum contents to climate change control. While male Chemistry teachers perceived all the Chemistry contents relevant to climate change control, female Chemistry teachers perceived some Chemistry contents not relevant to climate change control. The contents female Chemistry teachers perceived not relevant to climate change control include mixtures and compounds; symbols, formulae and equations; gas laws; separation techniques; acids, bases and salts; water; coal; the periodic table; chemical equilibrium; mass volume relationships; solubility; hydrogen; halogens; sulphur; electrochemical series; electrolysis; alkanols; titrations; qualitative analysis; metals and compounds; fats and oil; soap and detergent and giant molecules.

Hypothesis

HO_1. There is no significant difference in the mean rating scores of male and female Chemistry teachers on the relevance of Chemistry curriculum contents to climate change control ($p<0.05$)

Table 3: The t-test Analysis of Gender Difference in Teachers' Perception of Relevance of Chemistry Curriculum Contents to Climate Change Control

Groups	n	Mean	SD	df	t-value	p-value	Decision
Male	60	3.59	0.41	118	1.035	0.001	Significant
Female	60	2.61	0.37				

P<0.05

Result from Table 3 shows that the null hypothesis of no significant difference in the mean rating scores of male and female Chemistry teachers on the relevance of Chemistry curriculum contents to climate change control was refuted. This is because the probability value of 0.001 associated with gender difference in teachers' rating of relevance of Chemistry curriculum contents is less than 0.05 level of significance; ($t(118) = 1.035$, $P=0.001$).

Discussion of Findings

Results of this study show that chemistry curriculum contents are perceived relevant to climate change control by chemistry teachers in the senior secondary schools. This is a confirmation of the assertion of FME (2007) that the chemistry curriculum addresses the needs and aspirations of Nigerians in line with the contemporary global issues.

However, Table 2 shows that female chemistry teachers perceived twenty-three content areas not relevant to climate change control as against the male chemistry teachers' perception. The difference in perception of the relevance of chemistry curriculum contents to climate change control between male chemistry teachers and female chemistry teachers is found to be significant in Table 3. This is in agreement with Nwosu and Ibe (2012) who conclude that female Basic Science teachers significantly perceive some content areas differently from their male counterparts. The difference in perception of the relevance of chemistry curriculum contents to climate change control between male chemistry teachers and female chemistry teachers might imply that the female chemistry teachers could not relate those twenty-three content areas to current environmental challenges. This confirms the opinion of Yakob, Ismail & Razak (2012) to restructure chemistry curriculum in such a way that would address the climate change control.

The female chemistry teachers' inability to relate the chemistry content to the contemporary global issue such as climate change is a problem that poses danger to using chemistry education for sustainable development. This is in line with Nwosu & Ibe (2012) who maintain that observed female teachers' difficulty in teaching sciences is capable of denying students the attributes of sustainable education since the proportion of number of female teachers to male teachers in the secondary schools is high and on the increase. Thus the challenge of using chemistry education to provide solution for such national/global issue as the climate change control might stem from the high proportion of the chemistry teachers' ineffectiveness to make teaching

and learning of chemistry contents contextual. This is consonance with Igboanugo, 2019 who avers that the major challenge facing chemistry teaching and learning exercise for sustainable development is inability of chemistry teachers to relate chemistry instruction to life activities of the learner.

It is difficult to use chemistry for national development if chemistry instruction is not related to the societal needs and aspirations by the teacher. If the chemistry teacher does not recognize the relevance of the chemistry content to the solution for an existing problem such as climate change control he/she might not effectively use chemistry instruction as a tool for solving such an existing problem.

Recommendations

Based on the findings of the study the following recommendations are made:

1) Adequate attention should be paid by school proprietors on training and retraining of chemistry teachers on effective strategies of making chemistry instruction relevant to the learner and the society
2) Chemistry curriculum should be reviewed regularly by the curriculum planners to ensure its suitability/relevant to current societal need and aspiration such as climate change control
3) Cross fertilization of ideas in chemistry instruction should be encouraged by the school management among chemistry teachers for more efficient ones to sharpen the less efficient ones in making instruction relevant to the learner and the society
4) Adequate equipment and instructional materials should be provided by school proprietors to help make chemistry instruction relevant to societal issue such as climate change control.

Conclusion

This study has explored the perceived relevance of chemistry curriculum contents to a global issue of Climate change control by the teachers. Relevant chemistry curriculum content is expected to address societal need and aspiration such as climate change control and the inherent challenges. From this study, chemistry teachers have perceived that chemistry curriculum content can be of great value in mitigating climate change effects. Thus, adequate teaching and learning of the chemistry contents can be of good control or check in climate change consequential effects. Consequently, results of this study might be an eye opener to curriculum planners and implementers to be mindful of the relevance of the curriculum for tackling societal needs and ensure sustainable development. This calls for continual evaluation of chemistry curriculum for continuous suitability and sustainability. Again, results of this study might be a sensitization to gender dichotomy in chemistry pedagogy which should be borne in mind during recruitment and training/retraining of chemistry teachers.

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