THE GAP BETWEEN CHEMICAL EDUCATION AND DRIVE TO GREEN CHEMISTRY AS PERCIEVED BY LECTURERS OF CHEMISTRY IN IMO STATE

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Abstract
The perception of chemistry lecturers towards the structured curriculum presently in use in the higher institutions and its relationship to green chemistry was surveyed. A total population of one hundred and five lecturers from six tertiary institutions in Imo State which also was the sample size were used for the study. Research questions were used to obtain data, validated using the Chi Square statistical tool. The Chi-square calculated result showed X_C^2 *= 262.56 which was greater than the tabulated value of 5.99. The results therefore suggested that chemistry lecturers in Imo State believe there is a gap between the present day chemistry curriculum and green chemistry ideas and principles.*
Keywords: Chemical Education, Green Chemistry, Lecturers, Gap

Introduction

Green Chemistry refers to the aspect of Chemistry focused on mitigating the adverse effects of human activities to the natural environment. Over time, Green Chemistry has been incorporated as an integral part of green technology. The overall aim of Green Chemistry/Technology is its concern with the ways and means by which man keeps developing his environment without causing harm to the environment. Undoubtedly, green chemistry/technology has captained recent drive in the field of science and technology especially at a time when the world's attention is turned to sustainable development. (Pietro, Anastas, Black, Breen, Collin, Memoli, Miyamoto, Polyyakoff, & Tumas. 2000).

Green Chemistry has evolved from its roots in academic research to become a mainstream practice supported by academia, industry, and government. While Green Chemistry encompasses human health and the environment, it is guided by very specific principles of chemical practice. The interest in using green chemistry and its practices has extended internationally to become an alternative to traditional pollute-and-then-clean-up industrial practice in developing countries. This evolution is marked by significant contributions from institutions with different goals that are being satisfied through a common mechanism. (Akani, 2014)

Green chemistry is the use of chemistry for pollution prevention. More specifically, it is the design of chemical products and processes that are environmentally benign, (Maduewesi and Igbo, 2004) Green chemistry encompasses all aspects and types of chemical processes that reduce negative impacts to human health and the environment. At its best, green chemistry is environmentally benign, linking the design of chemical products and processes with their impacts on human health and the environment.

Van-Ejick (2007) stated that the implementation of green chemistry in the curriculum contributes to the general aims of science education, being an important element in the development of scientific literacy within the general public. Due to the importance of Green Chemistry in contemporary science and the recent drive towards sustainable development, most developed countries and many developing countries have included the concept into their high school and tertiary school curriculum. This however, has been done by these countries at different levels and to varying extents.

Sustainable development and Chemistry

In a world with a continuously increasing population and limited resources, the idea of a sustainable development should be of a major concern for the future (Okonkwo, 2010). It is only research and innovation that will allow the development of economic and social networks and process that fulfil the requirement of sustainability. The future has to be planned with visions, creativity and fantasy including brand new approaches and the explorations of the unknown. Sustainability in science and technology begins when we start thinking of how to solve a problem or how to turn science into technology. Chemistry as the science of matter and its transformation plays a central role in this process. It is the bridge between physics, material science and life sciences. Only chemical processes which have reached a maximum level in efficiency will lead to more sustainable products and production. Since scientist and engineers play a key role in those processes, their awareness, creativity and looking ahead is needed to bring reactions and chemical

processes to maximum efficiency, (Adejoh & Sambo, 2011).

Statement of problems

Environmental sustainability has been on the forefront of recent scientific drive. In order to enhance this drive, the Chemistry Discipline Network (CDN) has recently conducted a mapping exercise leading to a snapshot of the chemistry curriculum at twelve developed countries universities (Mitchell & Schultz, 2012). Its findings showed that only 25% of the universities investigated had made any change at all to their "state of education" and that this, by including a few specific units about sustainability, and some sustainability concepts in other units. This constitutes a 'bolt-on' response and is a weak approach indicating only cosmetic reform. The Nigerian curriculum for Science and Technology however as recently amended is expected to take care of the recent drive to environmental sustainability of which green chemistry is an integral part of. It is assumed that the practice of green chemistry in Nigeria is yet to gain acceptability due to poor knowledge of its concepts and principles. Spreading this knowledge and gaining the expected behavioural change is only achievable through chemical education. This paper therefore, analysed the chemistry curriculum for tertiary institutions to determine if there are any gaps between the chemistry curriculum for education and the drive towards green chemistry/technology that advocates environmental sustainability.

Method

Research Design:

This study employed a survey design which elicited information on the gap between chemical education and green chemistry as perceived by chemistry lecturers. A total of one hundred and five chemistry lecturers from five different tertiary institutions in Owerri Municipal Territory were interviewed. These institutions are Alvan Ikoku Federal College of Education, Imo State University Owerri, Imo State Polytechnic Umuagwo, Federal Polytechnic Nekede and Federal College of Lands Resources and Technology. Structured questionnaire was developed from the stated research questions and distributed to the entire population used for the study. The research questions include:

1. What role does chemistry education play in the drive to green chemistry?
2. Are there gaps between the chemistry education curriculum and the drive to green chemistry?
3. What are the measures that can be taken to close the gap between chemistry education curriculum and drive to green chemistry?

The validated structured questionnaire utilized four key point Likert scales with the following options and weights; Strongly Agree (4), Agree (3), Disagree (2), Strongly Disagree (1).

The Researcher approximated mean responses from 2.5 and above as positive and below as negative. Also, the null hypothesis H_o which signifies there is a gap between chemistry education and drive to green chemistry and H_a signifying that there is no gap between chemistry education and drive to green chemistry were used.

Results

The results obtained from the structured questionnaire were summarized in the tables below.

Table 1: Analysis of Responses as Regards the Role Chemistry Education Plays in the Drive to Green Chemistry

S/N	Items	SA	A	D	SD	Total	Mean	Remarks
1	Green chemistry has its own concept well imbibed in chemistry education	37	25	18	25	105	2.70	Accepted
2	Chemistry education relates its concept to the study of green chemistry	34	25	24	22	105	2.67	Accepted
3	Chemistry is the major science that can bring green chemistry to the knowledge of students	31	37	20	18	105	2.79	Accepted
4	Knowledge of green chemistry can be sustained within the scopes of chemistry education	36	33	19	17	105	2.81	Accepted
5	Chemistry education can provide students the base of connecting different disciplines of chemistry to green chemistry	38	31	19	17	105	2.85	Accepted

$$Mean = \frac{2.70 + 2.67 + 2.79 + 2.81 + 2.85}{5} = 2.70$$

Table 2: Analysis of the Responses of Respondents on the Gaps Present in the Chemistry Curriculum and Drive to Green Chemistry

S/N	Items	SA	A	D	SD	Total	Mean	Remarks
1	The Present Chemistry Curriculum does not reflect green chemistry ideas	69	36	0	0	105	3.6	Accepted
2	Curriculum planners, NUC and NERDC have failed to identify existing gaps between chemistry education and green chemistry	60	45	0	0	105	3.5	Accepted
3	There is need for an overhaul of the present chemistry curriculum and method of teaching chemistry	79	26	0	0	105	3.7	Accepted
4	Tertiary institutions must be on the forefront in the effort to bridge the gap between chemistry education and green chemistry	88	17	0	0	105	3.8	Accepted

$$Mean = \frac{3.6 + 3.5 + 3.7 + 3.8}{4} = 3.65$$

Table 3: Analysis of Responses of Respondents on the Measures that can be taken to close the existing gap between Chemistry Education and the Drive to Green Chemistry

S/N	Items	SA	A	D	SD	Total	Mean	Remarks
1	Incorporating chemistry ideas into the teaching and learning of chemistry must be ensured	88	17	0	0	105	4	Accepted
2	Chemistry lecturers must make a shift from the traditional way of teaching chemistry to modern ways	90	15	0	0	105	3.8	Accepted
3	Green chemistry awareness must be made in every situation where chemistry education is learned and practiced	95	10	0	0	105	3.7	Accepted
4	ICCON and CSN should ensure that green chemistry ideas are imbibed in their policies	80	25	0	0	105	3.7	Accepted

$$Mean = \frac{4 + 3.8 + 3.7 + 3.7}{4} = 3.90$$

Table 4: Summary of Data Obtained from the Survey

Responses	Question 1(X)	Question 2 (Y)	Question 3 (Z)	TOTAL
A (SA/ YES)	176	296	353	825
B(SD/NO)	99	0	0	99
TOTAL	273	296	353	924

A = SA, B= SD

Table 5: Calculation of (E_i) for Chi- Square

Responses	O_i	E_i	$O_i - E_i$	$(O_i - E_i)^2$	$(O_i - E_i)^2/E_i$
AX	176	244.2	-68.2	4651.24	19.04
AY	296	264.8	31.2	973.44	3.67
AZ	353	315.8	37.2	1383.84	4.38
BX	99	29.31	69.69	4856.6	165.69
BY	0	31.89	-31.89	1016.97	31.88
BZ	0	37.90	-37.90	1436.41	37.9
					$\sum$ = 262.36

Chi Square tabulated at 5% probability for r = 2, and c=3 5% (r) (c) = 5.99.

Inference: Since $X_c^2 = 262.56$ and $X_t^2 = 5.99$, we reject H_a and accept H_o. This implies that there is a gap between Chemistry Education and the drive to Green Chemistry as perceived by the chemistry lecturers in Imo State.

Discussion

Van-Ejick (2007) emphasized that the integration of green chemistry in the curriculum contributes to the general aims of science education, bearing in mind that science education is an important element in the development of scientific literacy. Green Chemistry as earlier stated evolved from academic research and has become accepted and supported by academia, industry, and government of most developed countries. The mean score of 2.7 in table 1 therefore supports the fact that chemistry education has significant roles to play in driving the practice of green chemistry principles.

The findings from this study show also shows as seen in the mean score of 3.65 from responses in table 2 that the concept and principles of green chemistry were not emphasised in the chemistry curriculum despite the globally accepted need for environmental sustainability. This can give an explanation to why there is still exist huge generation of and poor management of wastes that could have been avoided. Application of appropriated knowledge acquired enhances sustainable development but where there exists a gap between the contemporary societal need and knowledge acquired, the expected behavioural change cannot be achieved. Failure in this made it that practicing green chemistry principles is not seen as a necessity despite the fact that chemistry education is the major branch of science that brings us to the reality of our daily practices and the attendant effect on our environment. (Adejoh & Sambo, 2011). With concerted efforts by relevant bodies and varying approaches, the existing gap between chemistry education and drive to green chemistry can be closed as can be seen from the result in table 3.

Conclusion

Based on the data analysed, we conclude that chemistry lecturers in Imo State agree that chemistry education is indispensable in the drive to green chemistry. Although the present curriculum for chemistry education in use does not emphasize the practice of green chemistry principles, concerted efforts by relevant bodies can close the existing gap such that the global best practice for environmental sustainability can be inculcated in the society.

Recommendation

We therefore recommend various stakeholders in chemical education like the Chemical Society of Nigeria

and (CSN), the Institute of Chattered Chemists (ICCON), National Universities Commission (NUC) and National Commission for Colleges of Education (NCCE) to revisit their objectives, policies and standards with a view to making adjustments so as to incorporate application of green chemistry principles into the present day curriculum.

Again, the application of green chemistry principles should be emphasized in the practice of chemistry and chemical related processes.

Government and other relevant agencies should create greater awareness on the practice of green chemistry principles.

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