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Perceptions of Chemistry Teachers on Sustainable Development Goal Four in Nigeria: Implications for Curriculum Innovation

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Abstract: This study explores the perceptions of chemistry teachers in Nigeria regarding Sustainable Development Goal (SDG) four, which focuses on ensuring inclusive and equitable quality education. The study aims to understand how chemistry teachers perceive their role in achieving SDG four and to identify the challenges they encounter in integrating sustainability concepts into their teaching practices. The theoretical framework for the study is based on Education for Sustainable Development (ESD), which emphasizes the role of education in promoting sustainability. A descriptive survey design was adopted, and data was collected from 100 chemistry teachers using a 10-item structured questionnaire. The findings revealed that the teachers generally held positive perceptions regarding their contribution to SDG four, particularly in areas such as education for sustainable livelihoods, critical thinking, and human rights. However, the study also identified several challenges, including insufficient training, inadequate teaching resources, and lack of curriculum innovation, which hinder the effective integration of sustainable development concepts into chemistry education. The Chi-square test confirmed that the perceptions and challenges faced by the teachers were significant. Based on these findings, the study recommends improving in-service training for teachers, introducing curriculum innovations that incorporate sustainable practices, and enhancing laboratory facilities and resources to support effective chemistry teaching. These recommendations are aimed at aligning chemistry education with SDG four and contributing to the overall goal of sustainable development in Nigeria.

Keywords: Chemistry Education, Sustainable Development Goal (SDG) 4, Curriculum Innovation, Teacher Perceptions, In-service Training, Challenges in Education, Teacher Competency.

Introduction

Chemistry is an incredibly fascinating field of study. Because it is so fundamental to our world, chemistry plays a role in everyone's lives and touches almost every aspect of our existence in some way. Chemistry is essential for meeting our basic needs of food, clothing, shelter, health, energy, air, clean water and soil. Knowledge of the nature of chemicals and chemical processes therefore provides insights into a variety of physical and biological phenomena. Knowing something about chemistry is worthwhile because it provides an excellent basis for understanding the physical universe we live in (Shazli, 2013). Chemistry is the scientific study of the properties and behaviour of matter. It is a physical science under natural sciences that covers the elements that make up matter to the compounds made of atoms, molecules and ions: their composition, structure, properties, behaviour and the changes they undergo during a reaction with other substances (Shazli, 2013). Chemistry also addresses the nature of chemical bonds in chemical compounds. In the scope of its subject, chemistry occupies an intermediate position between physics and biology. It is sometimes called the central science because it provides a foundation for understanding both basic and applied scientific disciplines at a fundamental level of education.

Education has been said to be the activity of preserving, developing and transmitting the culture of people from one generation to another (Okno-Saye Orobite, as cited in Ekwueme, Ekon & Ezenwa-Nebife, 2016). Education is instrumental for the development of knowledge, skills and values which enable people take part in decision making about them, individually, collectively and globally. This vision of development embraces environmental concern as well as issues such as the fight against poverty, human right, gender equality, cultural diversity and education for all. To this end, Education is a means through which sustainable development can be achieved. Education for sustainable development allows every human being to acquire knowledge, skills, attitudes and values necessary to shape a sustainable future. According to Nayar (2013), sustainable development is a development that meets the needs of the present without compromising the ability of future generation to meet their own needs. Nayar (2013) further stressed that sustainable development promotes critical thinking and decision making in a collaborative manner.

The concept of sustainability education is based on the terms sustainability and education. The term sustainability is derived from the Latin word “sustinere”. The former is a model of thinking in which the quality of life is improved through balancing the environment, society and the economy (Jeronen, 2013). The latter refers to an activity or process for acquiring or sharing knowledge or skills, developing the powers of reasoning and judgement, and intellectually preparing oneself or others for life (Thesaurus, 2021). Many of today challenges require a veritable shift in thoughts and behaviour to support sustainability living. The necessary cultural change can be achieved through sustainable education. He defines the concept as a change of educational culture, one which develop and embodies the theory and practice of sustainability in a way which is critical aware.

Education for sustainability could explore students and create opportunities for them to learn and examine how the resources they use affect the Earth. Education for sustainability includes learning about the environment, interacting with the environment to make choices and prevent harmful activities in the environment. No wonder why Millennium Development Goals (MDGs) seeks to ensure environmental sustainability which is indicative of the global concerns for the environment. In line with this, Reid, Green, Cooper, Hastings, Lock & White, (2010) remarked that climate change was one of the major issues discussed at the G8 summit in Germany in 2007. Education for sustainable development fosters and strengthens the capacity of individuals to make judgments and choices in favor of sustainable life style. According to Wal (2010), Education for Sustainable development is a type of education that enables students and entire society to learn and make choices that incorporate the essential principles and values of Sustainable development.

He further defines education for sustainable development as a lifelong process that leads to an informed and involved citizenry having the creative problem-solving skills, scientific and social literacy, and commitment to engage in responsible individual and co-operative actions. From these definitions, it can be deduced that education is an essential ingredient for sustainable development.

Goal four of Sustainable Development Goals (SDGs) advocates inclusive and equitable quality education and promote lifelong learning opportunities for all. According to the United Nations Education Scientific and Cultural Organisation [UNESCO](2020),education is a top priority because it is a basic human right, and the foundation on which to build peace and drive sustainable development. The knowledge of mathematics education helps one to acquire basic functional skills for self-reliance, and has the economic benefits of better preparing one for numeracy skills demands of modern industrial work place (Garba, 2014; & Wetmore, 2017).

The way Chemistry concepts are developed and taught will go a long way in assisting students to improve on their understanding of both concepts and applications in life. Chemistry teachers are supposed to develop and present Chemistry contents in a way that students will think critically in order to identify relationships between Chemistry and their environment. There is no gain saying that when students understand their natural environment they can engage in exploits that could ensure its sustainability. So, through the instrumentality of Chemistry, a country like Nigeria that desires self-reliance and sustainability of its citizens in the face of current trends of unsustainable education policies, should attune to the 17 Sustainable Development Goals(SDGs) adopted by the United Nations General Assembly on September 25, 2015. Chemistry teachers are trained to help students acquire knowledge but if they are unable to keep up to date on current issues through in-service training and retraining relating to the environment and society at large, students studying under the teacher may find it difficult to function or adapt to environmental trends thereby limiting the success of sustainable development goal four.

Objectives of Sustainable Development (SDGs) in Education

To ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, Goal 4 of the United Nation's Sustainable Goals as cited in United Nations (2023) targets:

1. By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and Goal-4 effective learning outcomes

2. By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education

3. By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university

4. By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship

5. By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations

6. By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy

7. By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development

8. Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, nonviolent, inclusive and effective learning environments for all

9. By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small islands developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries

10. By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing states.

In view of the above objectives, it can be deduced that goal four intends to bring about sustainable development in Nigeria's Education.

Statement of the Problem

The objectives of the Sustainable Development (SDGs) Goal four can only be achievable if only the curriculum is functional and up to date. Chemistry teachers need to understand how to apply chemistry principles in solving education, environmental and societal problems. Unfortunately, current economic situation in Nigeria may have affected the sustainability of effective teaching and learning thereby delaying the achievement of Goal four of SDGs. Insight into the area of teacher knowledge, beliefs and applied pedagogies concerning education for sustainability remains rare. The ability to teach and create a sustainable environment for a particular way in which human live for the current generation and having future generations in mind has been the problem of most teachers in Nigeria schools. The creation and protection of a valuable human ecology should be a concern for all stakeholders, (Government, schools, communities and especially the teachers). This is because the state of the natural environment at a given time impacts the quality of life of the generation at that time; since humans are integral, dependent part of that natural environment (Gary and Thomas, 2010).Teachers remain the most important factor for curriculum reforms and innovations. What teachers think, believe and know affects their teaching. It is based on these problems that this study is designed to find out level of knowledge and perceptions of Chemistry teachers towards Sustainable Development Goals in Education.

Purpose of the Study

The purpose of the study is to examine the perceptions of Chemistry teachers on Sustainable Development Goal four in Nigeria: implications for curriculum innovation. Specifically, the objectives of the study were to:

1. to ascertain Chemistry teachers' perceptions on achieving Sustainable Development Goal four through Chemistry.
2. to identify challenges faced by Chemistry teachers in integrating Sustainable Development Goals four into Chemistry teaching.

Research Questions

The study addressed the following research questions:

1. What are Chemistry teachers' perceptions on achieving Sustainable Development Goal four through Chemistry?
2. What are the challenges faced by Chemistry teachers in integrating Sustainable Development Goal four into Chemistry teaching?

Hypotheses

HO1: The perceptions of Chemistry teachers on achieving Sustainable Development Goal four through Chemistry is not significant.

HO2: There are no significant challenges faced by chemistry teachers in integrating Sustainable Development Goal four into Chemistry teaching.

Methodology

The research design adopted for this study was a descriptive survey design. Two research questions and two hypotheses were raised for the study. The study was carried out in Obio-Akpor Local Government Area, Rivers State. The population of the study comprised 120 Chemistry teachers from selected public secondary schools in Obio-Akpor Local Government Area. The sample size consisted of 100 Chemistry teacher selected using multi-stage sampling techniques. The data collecting instrument adopted for the study was a 10 item structured questionnaire. The questionnaire was captioned Chemistry Teachers' Perceptions Questionnaire (CTPQ). The questionnaire employed the modified 4-point Likert scale.

The face and content validity of the instrument was evaluated by two experts from the Department of Measurement and Evaluation, Michael Okpara University of Agriculture, Umudike and one expert from the Department of Chemistry Educationa, Ignetus Ajuru University of Education, Rumuolumeni, Port Harcourt, Rivers State. The instrument was validated with reliability coefficient of 0.75. Research questions were analysed using mean and standard deviation while Chi square was used for hypotheses. All were carried out at 0.05 level of significance. Criterion value for decision making is mean of 2.50, therefore, any calculated mean greater than or equal to 2.50 (X≥) was accepted as adequate while calculated mean less than 2.50 (X<) was rejected.

Results

Research Question 1: What are Chemistry teachers' perceptions on achieving Sustainable Development Goal four through Chemistry?

Table 1: Mean respondents on Teachers‟ Perception on Achieving Sustainable Development Goal four through Chemistry Education

S/N	Items	N	X	SD	Remark
1.	Education for sustainable vocational training for world of work.	100	3.33	0.62	Agree
2.	Education that increases the knowledge and comprehension of ever dynamic society.	100	3.11	0.74	Agree
3.	Education for human right and gender equality.	100	2.91	0.88	Agree
4.	Education for critical thinking and problem solving skills.	100	2.77	0.99	Agree
5.	Education for peaceful environment and sustainable society.	100	3.15	0.78	Agree
	Total		**3.05**	**0.80**	

Source: Researcher's field survey, 2024

Table 1 shows the mean respondents and standard deviation on chemistry teachers' perceptions on Sustainable Development Goals four. The analysis of the table indicates that all the respondents agree from item 1-5 with overall mean score of 3.05 greater the decision rule of 2.5 and therefore accepted.

Research Question 2: What are the challenges faced by Chemistry teachers in integrating Sustainable Development Goal four into Chemistry teaching?

Table 2: Mean respondents on challenges faced by Chemistry teachers in integrating Sustainable Development Goal four into Chemistry teaching

S/N	Items	N	X	SD	Remark
1.	Poorly equipped Chemistry laboratories and teaching resources in schools.	100	3.00	0.62	Agree
2.	Chemistry teachers are unsatisfied with their job.	100	2.25	1.43	Disagree
3.	Chemistry teachers' in-service training and retraining in-line with (SDGs) goal 4.10 is insufficient.	100	3.33	0.61	Agree
4.	Inadequate facilities for effective Chemistry teaching and learning environment in-line with (SDGs) goal 4.8.	100	3.11	0.74	Agree
5.	Lack of curriculum innovation in Chemistry in-line with (SDGs) goal 4.4	100	3.40	0.58	Agree
	Total		**3.01**	**0.80**	

Source: Researcher's field survey, 2024.

Results in table 2 shows that chemistry teachers agree 3(3.33), 4(3.11), and 1(3.00) that they are faced with challenges in integrating Sustainable Development Goal 4 in Chemistry teaching. Chemistry teachers are particularly concerned about lack of curriculum innovation in chemistry in-line with (SDGs) 4.4 with the highest mean score of 5(3.40). Respondents however disagree 2(2.25) that they are dissatisfied with their job.

Hypotheses

Hypothesis 1: The perceptions of Chemistry teachers on achieving Sustainable Development Goal four through Chemistry is not significant.

Table 3: Chi square test showing the perceptions of Chemistry teachers on achieving Sustainable Development Goal four through Chemistry.

Response	Observed	Expected	df	X^2 value	P-value	Decision
SA	43	25	3	23.54	0.00	Rejected
A	29	25				
D	16	25				
SD	12	25				

Table 3 shows the Chi square result on the perceptions of Chemistry teachers on achieving Sustainable Development Goal four through Chemistry. Since the p-value (= 0.00) is less than the level of significance α (= 0.05), the null hypothesis is therefore rejected and the result summarized thus:

H1: ρs ≠ 0: The perceptions of Chemistry teachers on achieving Sustainable Development Goal four through Chemistry is significant. This implies that Chemistry teachers have strong and positive perceptions towards the achievement of Sustainable Development Goal four through Chemistry teaching.

Hypothesis 2: There are no significant challenges faced by chemistry teachers in integrating Sustainable Development Goal four into Chemistry teaching.

Table 5: Chi square test showing the challenges faced by chemistry teachers in integrating sustainable development goals four in Chemistry teaching.

Response	Observed	Expected	Df	X^2 value	P-value	Decision
Yes	61	50	1	2.44	0.00	Rejected
No	49	50				

Table 4 shows the Chi square result on the challenges faced by chemistry teachers in integrating Sustainable Development Goal four into Chemistry teaching. Since the p-value (= 0.00) is less than the level of significance α (= 0.05), the null hypothesis is therefore rejected and the result summarized thus:

H1: ρs ≠ 0: There are significant challenges faced by chemistry teachers in integrating Sustainable Development Goal four into Chemistry teaching. This indicates that Chemistry teachers are faced with challenges militating against effective integration of Sustainable Development Goal four into Chemistry teaching.

Conclusion

Based on the findings of the study, it was concluded that Chemistry teachers have strong and positive perceptions towards the achievement of Sustainable Development Goal four through Chemistry teaching. There is no gain saying that chemistry is a vocational oriented science subject and a catalyst for preparing students for future studies or into a world of work, leading to sustainable development. However, this study indicates that Chemistry teachers are faced with numerous challenges ranging from insufficient training and retraining of teachers, inadequate facilities for effective Chemistry teaching and learning environment to lack of curriculum innovation in Chemistry. These challenges may militate against the achievement of Sustainable Development Goals (SDGs) goal 4 in terms of Chemistry teaching and learning at secondary schools level in Nigeria.

Recommendations

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

1. A concerted effort should be made by Government and education based Non- Governmental Organisations to improve Chemistry teachers' competencies in Chemistry pedagogical and content knowledge. This could be done through in-service training, workshops, seminars, conferences and perhaps through UNESCO sponsored programmes involving international cooperation for training teachers in developing countries.
2. There should be innovations in Chemistry curriculum involving entrepreneurship and vocational training to empower Chemistry teachers with skills for education for sustainable development.
3. As a matter of urgency, Government should provide equipped/functional Chemistry laboratories and instructional resources to facilitate effective teaching and learning activities.

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