# POSTGRADUATE STUDENTS' PERSPECTIVE ON CURRICULUM INNOVATION IN CHEMISTRY FOR SUSTAINABLE DEVELOPMENT

**BY**

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## Abstract

This study quantitatively explores postgraduate students' perception on curriculum innovation in chemistry for sustainable development. A survey of 200 postgraduate chemistry students across various universities in Kwara state, Nigeria was conducted. The survey evaluated the postgraduate students' views on the integration of sustainability concepts into the chemistry curriculum, the perspectives and the opportunities in integrating sustainability concepts into chemistry curriculum and impact of integration of sustainability concepts into chemistry curriculum on students' understanding of chemistry concepts and their ability to apply them. The findings indicated strong support among postgraduate students for incorporating sustainability into the chemistry curriculum (average of means = 2.08, S.D -= 0.940), believing it would enhance their understanding of the subject and prepare them for real-world challenges. Additionally, there was no significant difference in the male and female perception and views on curriculum innovation in chemistry for sustainable development (*t-cal*. = 0.90 which is less than *t-table* = 1.96). The results suggest that integrating sustainable development into chemistry education can foster a generation of chemists equipped to tackle global challenges. Recommendations include further curriculum updates to include sustainability, as well as training for educators to effectively teach these concepts.

**Keywords:** Chemistry curriculum innovation, Sustainable development, Postgraduate students' perspectives, Educational reform

## Introduction

As the world grapples with environmental challenges and strives for sustainable solutions, there is a growing recognition of the need to integrate sustainability principles into higher education curricula, including those in the field of chemistry. Understanding how postgraduate students perceive and engage with curriculum innovation is crucial for designing effective educational interventions that prepare future chemists to address global sustainability issues.

Recent research has highlighted the significance of considering students' perspectives when designing and implementing curriculum innovations (Smith & Harder, 2023). Postgraduate students, in particular, bring a wealth of knowledge, experiences, and aspirations to the learning environment, making their viewpoints valuable for shaping educational initiatives. By exploring postgraduate students' perspectives, educators and policymakers can gain insights into the effectiveness of current curriculum innovations, identify areas for improvement, and tailor educational approaches Sustainable development has been defined as a development that meets the needs of the present without compromising the ability of the future generation to meet their need. The concept of sustainable development emphasizes that education should be geared to prepare students to take responsibility for themselves and their society by today and in the future. Most Chemistry students from secondary schools cannot apply methods and principles taught or how relate the theories to practical everyday living or see Chemical knowledge as a tool for wealth creation. therefore, there is a need to review the curriculum for teaching Chemistry in secondary school, to create a functional and relevant Chemistry curriculum that would meet the societal demand, awaken interest in the subject in students aid the sustainability of scientific and technological development in the country.

The Postgraduate study programmed in Chemistry Education is the development of professional chemistry teachers, educators and administrators who will be social agents of change through education in chemistry, researches and administration of chemical education.

The Objectives of M.Ed. programmed in Chemistry Education are:

i) production of high caliber professional Chemistry teachers, educators and administrators;
ii) development of knowledgeable and competent scholars who possess requisite research skills in Chemistry education.
iii) production of high-level work force that can initiate and or implement policies in the area of chemistry education for technological and industrial development.
iv) produce Chemistry teachers, educators and administers who can give Nigerian education a national identity while making relevant impact in the global context through exploration of cultural contents and context of chemistry education.

Job Opportunities Successful graduates of the above programmed have ample teaching opportunities with various ministries of education, research institutes, Universities, Colleges of Educations, Polytechnics or private schools in Nigeria or elsewhere in the world. They also have job opportunities as educational administrators in the ministries of education, educational institutions and educational parastatals. Developing and implementing educational policy is aided by researching curricular innovation through curriculum definition and creation. Studies that take this approach to curricular innovation seek to create strategies that are effective, long-lasting, and developmental. Examples of these studies include those Most Chemistry students from secondary schools are not able to apply principles taught or how to relate the theories with the practical everyday living or see Chemical knowledge as a tool for wealth creation. There is therefore a need to review the curriculum for teaching Chemistry in the secondary school, to create a functional and relevant Chemistry curriculum that would meet the societal demand, awaken interest for the subject in students and aid the sustainability of scientific and technological development in the country. conducted by Franco, Saito, Venter, and colleagues (2019) and Bovill and Woolmer (2019) on the impact of higher education curriculum conceptualizations on student-staff co-creation.

A systematic program of study and research created for students who have finished their undergraduate studies in chemistry or a similar discipline is known as a postgraduate chemistry curriculum. It offers the advanced know-how, proficiency, and competence required for employment in government, business, university, or research facilities. A combination of coursework, seminars, and original research conducted under the supervision of academic mentors are usually included in the program. The study of chemistry in schools, colleges, and universities is known as chemistry education. Understanding how students learn chemistry, how to teach chemistry effectively, and how to change teaching strategies and provide chemistry educators with the right training are all included in chemistry education.

Chemistry is an important science subject taught across secondary to tertiary levels of education. It is a core science subject that permeates other science disciplines thereby equipping individual students with scientific knowledge, skills, attitudes and aptitudes for self-reliance. It is necessary to produce the technologists, technicians, engineers, and physicians needed to revive the country's economy and bring about the much-needed technical innovation that is essential to sustainable growth. Restructuring the Nigerian curriculum is necessary to support long-term, sustainable national growth. The nation's economic difficulties are not adequately addressed by the existing formal curriculum (Aderinoye & Ojokheta, 2021; Alade, 2020). Chemistry education is regarded as a vital development tool, whether it is for personal freedom, empowerment, or the development of human potential and a trained labour force for modernization. Nigeria is still plunging headfirst into a murky draw in an attempt to find a means of ending her complete reliance on other countries for scientific and technological know-how.

Scientific and technological advancements have ushered in a new era of educational systems for the twenty-first century, marked by several innovations that support the reform of chemistry education at all levels of education. The majority of educational policies are well thought out and incorporate necessary elements for sustainability, diversity, and digitization. Chemistry is vital in addressing societal issues and assisting in the accomplishment of the Sustainable

Development Goals (SDGs) of the United Nations. Recent years have seen a significant increase in interest in chemistry education as well as the reconsolidation of chemistry education through creative teaching techniques. The Sustainable Development Goals (SDGs) were developed with a number of objectives in mind, including social justice and economic progress. Universities have been tasked with transforming their curricula to incorporate Education for Sustainable Development (ESD) in order to educate students for sustainable development, this will help them achieve the goals. Although a few of colleges have modified their courses to incorporate Education Sustainable Development, existing research indicates that these changes are insufficient to meet the Sustainable Development Goals. Prior research has mostly concentrated on the measures used by governments to accomplish the objectives, with little attention paid to the curricular model that Nigerian universities should employ to incorporate Education Sustainability Development into their curricula. Chemistry curriculum should be practically oriented to develop skills needed for sustainable development and at the same time for movement to higher education.

Therefore, the purpose of this study is to quantitatively explore postgraduate students' perspectives on curriculum innovation in chemistry for sustainable development. Which will address the justification by evaluating the impact of postgraduate student's perspective on curriculum innovations for sustainable development, the research will explore how these changes influence students' perspective on postgraduate chemistry curriculum innovation towards chemistry and their academic results, thereby providing insights into the integration sustainability on educational reforms and suggesting areas for further improvement , this is important in policy decision to foster understanding scientific problems for Nigerian students.

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**Purpose of the study**

The general purpose of this study is to evaluate the Postgraduate students' perspective on curriculum innovation in chemistry for sustainable development. Specifically, this study will:

1. Examine the perspectives and the opportunities in sustainability practice of chemistry concepts among the student.
2. Evaluate the students' difference in view of integrating sustainability of curriculum innovation in chemistry.

**Research Questions**

The following questions were asked to guide the study;

1. What are the perspectives and the opportunities in integrating into chemistry?
2. The difference in the perception and integration of sustainability concepts into chemistry curriculum impact students' understanding of chemistry?

**Hypotheses**

In line with the purpose of the study, two null hypotheses were formulated and tested at 0.05 level of significance:

**$H0_1$:** There is no significant difference in the perspectives and the opportunities in integrating sustainability concepts into chemistry based on gender.

**$H0_2$:** There is no significant difference in the perception of sustainability concepts into chemistry curriculum on students' understanding of chemistry based on gender.

**Significance of the study**

This study may be useful to educators, educational researchers, and curriculum developers and policy makers.

**Literature Review**

Through this literature review, we aim to synthesize existing research findings, identify trends and gaps in the literature, and provide recommendations for future curriculum development efforts in chemistry education. By shedding light on postgraduate students' perspectives on curriculum innovation, this review seeks to contribute to ongoing discussions and efforts to promote sustainable development in higher education. This study investigates the perspectives of postgraduate chemistry students on integrating sustainable development principles into the curriculum. Findings reveal a strong desire among students for more emphasis on sustainability-related topics, with suggestions for innovative teaching methods and interdisciplinary approaches. (Smith, Johnson & Lee, A. (2022).

In their study, Vandenbussche *et al*. (2006) present an extended model of endogenous growth that accounts for the dynamics of innovation and imitation within the innovation sector. They highlight the distinction between innovation and imitation activities and emphasize the critical role of human capital, specifically education, in fostering innovation. Their model recognizes that innovation requires higher levels of education compared to imitation activities. Building upon these insights, Vandenbussche *et al*. (2006) investigated the impact of increasing the education level on productivity growth. They found that investing in higher education, particularly in developing high skills, leads to enhanced productivity growth, especially in economies closer to the global technological frontier. In contemporary research, similar studies continue to explore the relationship between education, innovation, and economic growth. For instance, recent work by Acemoglu *et al.,* (2021) delves into the mechanisms through which investments in education influence technological progress and economic development. By incorporating insights from empirical data and theoretical models, current research sheds light on the nuanced dynamics of human capital accumulation and its implications for innovation-driven growth.

Chemistry is vital in addressing societal issues and assisting in the accomplishment of the Sustainable Development Goals (SDGs), recent years have seen a significant in chemistry education as well as the reconsolidation of chemistry education through creative teaching techniques. The objective of education is sustainable development, which is becoming more and more important as people realize how urgent it is to achieve sustainable development. Innovative curricula give teachers the chance to create specialized learning environments. These innovations are implemented in the classroom under the direction of the development resources. Changes to the curriculum have produced beneficial results for many schools. Therefore, curriculum innovation involves experimenting with the curriculum's flexibility through the introduction of novel techniques to managing subject matter and the modification of instructional strategies (Daramola, 2008). To be more driven to learn and do more, young people need to be involved in this kind of process.

Chemistry curricula are now developed with the Sustainable Development Goals in mind for all educational levels. In the global age, chemistry instructors have a number of obstacles. For example, they must train their graduates to think and act systematically while expecting them to acquire the majority of their knowledge in a linear fashion. Curricular innovation has been and is being examined in terms of changes in methods, forms, techniques, means, contents, objectives, etc It explains curricular innovation in terms of modernizing, reframing, and streamlining the university program. This speaks to the content, methodological, and organizational aspects of education.

**Methodology**

This study is a descriptive type of the survey method. The target population of this study was all chemistry postgraduate students of all universities in Kwara state, Nigeria. Two hundred (200) postgraduate chemistry students, the population for this study focused mainly on all postgraduate students in all nine (9) universities in Kwara state, Nigeria. A sample of 200 postgraduate chemistry students were randomly selected in all three-senatorial district of Kwara state, obtained from nine universities in Kwara state using stratified random sampling technique. The researcher was very conscious of the fact that Kwara state is made up of three senatorial districts (Kwara Central, Kwara North and Kwara South). Kwara State university Kwasu, Al- Hikmah University, Sheikh Kamaldeen University were

selected from Kwara Central; Ahman Pategi University, Ojaja University were selected from Kwara North, while University of Ilorin, Summit University, Landmark University and Thomas Adewumi University were selected from Kwara South senatorial district of Kwara state. The researchers ensured that the respondents were distributed equally among the senatorial districts of the state.

The instrument used for this study was a validated questionnaire titled "Postgraduate Students' Perspective on Curriculum Innovation in Chemistry for Sustainable Development Questionnaire, PSPCICSDQ" with the aim of generating required data that are generalized on the whole population. Each copy of the questionnaire was constructed to contain parts A and B and have a few well-chosen questions related to the objective of the study. The part A of the questionnaire contained questions used to collect personal data such as gender, the school type e. t. c. while part B sought information on perspectives and opportunities, of integrating sustainability concepts into chemistry curriculum. In other to achieve this, the researchers sought for the help of experts and lecturers in the department of science education to scrutinize and make necessary corrections of the various items in the instrument in order to ensure that the instrument was validated by the experts. The instrument was then trial tested using test and retest method. It produced a reliability coefficient of 0.81 using Pearson Product Moment Correlation Coefficient. Mean and standard deviation was used to analyze the data for answering the research questions while t-test was used in testing the hypothesis at 0.05 level of significance. To affect the decision for the research questions, where a mean score was 2.50 and below, that means the respondents 'agreed' but when the mean score was 2.50 and above, the respondents 'disagree' with the statement or question. In the case of hypotheses, where the calculated value of t-test (t-cal.) was less than the critical value of t-test in the t-table (t-table), the null hypothesis is accepted. In the like manner, where the calculated value of t (t-cal.) exceeded the critical value in the t-table (t-table), the null hypothesis is rejected.

**Presentation of Findings**

**Research Questions 1:** What are the perceptions and opportunities in integrating sustainability concepts into chemistry?

**Table 1**
*Mean and standard deviation of responses to the perception and opportunities in integrating sustainability concepts into chemistry*

| S/N | Challenges and opportunities | Mean | Standard Deviation | Decision |
|---|---|---|---|---|
| 1. | Integrating sustainability concepts into chemistry education is essential for preparing students for a sustainable future. | 2.06 | 0.900 | Agreed |
| 2. | Lack of resources and funding is a major challenging in integrating sustainability concepts into chemistry research and development. | 2.06 | 0.928 | Agreed |
| 3. | Sustainability concepts are relevant to all areas of chemistry including organic, inorganic, physical and analytical chemistry. | 2.04 | 0.937 | Agreed |
| 4. | Incorporating sustainability development into chemistry curriculum enhances better understanding of the subject. | 2.16 | 0.995 | Agreed |
| | **Grand mean** | **2.08** | **0.940** | **Agreed** |

Source: Field Data, 2024

As indicated by the means and the grand mean in Table 1 which are all less than the criterion means of 2.50, it is therefore agreed that integrating sustainability concepts into chemistry education is essential for preparing students for a sustainable future, relevant to all areas of chemistry and enhance better understanding of the subject while lack of resources and funding is a major challenge.

**Research Questions 2**

**Table 2**

*Mean and standard deviation of responses to the perception and opportunities in integrating sustainability concepts into chemistry*

| S/N | Impact of sustainability concepts into chemistry on students' understanding. | Mean | Standard Deviation | Decision |
|---|---|---|---|---|
| 1. | Will integration of sustainability concepts in chemistry curriculum improves student's interdisciplinary research and collaboration? | 2.11 | 0.958 | Agreed |
| 2. | Can chemistry education students with integrating sustainability concepts helps in developing innovative solution for real-world problems? | 2.05 | 0.881 | Agreed |
| 3. | Will students who learn sustainability concepts in chemistry be better equipped in communicating scientific information? | 2.13 | 0.868 | Agreed |
| 4. | Students who learn sustainability concepts in chemistry are more likely to pursue careers in sustainable industries. | 2.16 | 0.978 | Agreed |
| | **Grand mean** | **2.11** | **0.921** | **Agreed** |

Source: Field Data, 2024

As indicated by the means and the grand mean in Table 2 which are all less than the criterion means of 2.50, it is therefore agreed that integrating sustainability concepts into chemistry education improves students' interdisciplinary research and collaboration, develops innovative solutions for real world problems, equipped them in communicating scientific information and will make them pursue careers in sustainable industries.

**Hypothesis Testing**

**Ho1:** There is no significant difference in the students' perception of the challenges and opportunities in integrating sustainability concepts into chemistry based on gender.

**Table 3**

*t - test analysis of perception and opportunities in integrating sustainability concepts into chemistry based on gender*

| **Source** | **Mean** | **Std** | **N** | **Df** | ***t* –cal** | ***t* –table** |
|---|---|---|---|---|---|---|
| Male | 2.02 | 0.934 | 96 | 199 | 0.90 | 1.96 |
| Female | 2.28 | 1.038 | 104 | | | |

Source: Field Data, 2024

From Table 3, the *t-cal* of 0.90 is less than *t-table* value of 1.96 and therefore, the null hypothesis is accepted. This means that there is no significant difference in the perception of male and female respondents the students' perception and opportunities in integrating sustainability concepts into chemistry based on gender.

**Ho2:** There is no significant difference in the impact of integration of sustainability concepts into chemistry curriculum on students' understanding based on gender.

**Table 4**

*t - test analysis of impact of sustainability concepts integration on students' understanding based on gender*

| Source | Mean | Std | N | *Df* | *t –cal* | *t –table* |
|---|---|---|---|---|---|---|
| Male | 2.02 | 0.934 | 96 | 198 | 0.29 | 1.96 |
| Female | 2.28 | 1.038 | 104 | | | |

Source: Field Data, 2024

From Table 4, the *t-cal* of 0.29 is less than *t-table* value of 1.96 and therefore, the null hypothesis is accepted. This means that there is no significant difference in the male and female postgraduate students' perception of the impact of integration of sustainability concepts into chemistry curriculum on students' understanding of chemistry concepts and their ability to apply them.

**Discussion of Findings**

This study investigated postgraduate students' perspective on curriculum innovation in chemistry for sustainable development in Ilorin, Nigeria. The result of the findings showed that there was no significant difference in postgraduate students' perspective on curriculum innovation in chemistry for sustainable development. Considering the analysis of data in table 3, it has shown that the results of the analysis is supported the proposition in alternative hypothesis (ii) that: postgraduate students' perception of the impact of integration of sustainability concepts into chemistry curriculum on students' understanding of chemistry concepts and their ability to apply them, However, the analysis in table 4, revealed that the result which supports the difference in the alternative hypotheses (i) that: postgraduate chemistry students' perception has improved the challenges and opportunities in integrating sustainability concepts into chemistry based on their gender.

**Conclusion**

In conclusion, the postgraduate student's perspective on curriculum innovation in chemistry for sustainable development has a significant impact on integrating sustainability concepts into chemistry education which is essential for preparing students for a sustainable future, relevant to all areas of chemistry and enhance better understanding of the subject. Also, integrating sustainability concepts into chemistry education improves students' interdisciplinary research and collaboration, develops innovative solutions for real world problems, equipped them in communicating scientific information and will make them pursue careers in sustainable industries.

**Recommendations**

**Educators:** Encourage interdisciplinary approaches in teaching chemistry and provide professional development.

**Postgraduate student:** Participate in professional development opportunities to stay updated on the latest trends and practices in sustainable chemistry

Use of digital resources and multimedia material to enhance student engagement and learning suggestions for further study should investigates the impact of curriculum innovation on postgraduate students learning outcomes and career choices in sustainable chemistry.

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