



Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idirisu, J. L., Et. al. (2026)

Correlation between Green Chemistry Awareness, Entrepreneurial Skills and Sustainability Literacy on Innovation Intention among Colleges of Education Pre-Service Teachers in Niger State, Nigeria

IDIRISU, Jibril Limangba¹

chemistlimangba@gmail.com

USMAN, Abdullahi Muhammad²

abdulus0764@gmail.com

BAWA, Swafiah³

bawaswafiyah@gmail.com

YAHAYA, Ibrahim Alfa⁴

yahayai7945@gmail.com

MAGAJI, Buhari²

buharimagajislm@gmail.com

¹Department of Chemistry, Baze University, Abuja

²Chemistry Department, Federal University of Education Kontagora, Niger State

³Department of Chemistry, Federal University of Education Zaria, Kaduna State

⁴Department of Science Education, Federal University of Technology, Minna, Niger State

Abstract

This research investigated into the role of green chemistry awareness, entrepreneurial skills, and sustainability literacy as predictors of innovation intention of pre-service teachers in Niger State, Nigeria. This study was carried out using a descriptive correlational survey design. The population of the study was final year chemistry education students in the teacher education institutions in Niger State. A total of 240 pre-service chemistry teachers were randomly sampled from the population using the simple random sampling technique at Dr. Umaru Sanda Ahmadu College of Education, Minna and Federal College of Education, Kontagora. Data were gathered using a structured questionnaire titled Green Chemistry Awareness, Entrepreneurial Skills, Sustainability Literacy and Innovation Intentions Questionnaire (GCAESLIQ). This instrument was face validated by experts in chemistry education, entrepreneurship education and measurement and evaluation. The instrument was also pilot tested on 30 chemistry education students at Federal College of Education, Zuba, Abuja. Cronbach's Alpha coefficients obtained were 0.82, 0.85, 0.80 and 0.84 for green chemistry awareness, entrepreneurial skills, sustainability literacy and innovation intentions respectively. The overall reliability coefficient was 0.83. Data collected was analysed using Pearson Product Moment Correlation and multiple regression at 0.05 level of significance. From the study, it was observed that green chemistry awareness, entrepreneurial skills and sustainability literacy have a significant positive relationship with innovation intention of pre-service teachers in Niger State. These variables also accounted significantly to innovation intentions of the pre-service teachers with entrepreneurial skill being the best predictor of the innovation intentions. The study concluded that efforts should be made to enhance sustainability education and entrepreneurial skills of pre-service chemistry teachers to boost their innovation intentions and achieve sustainable development of the country.

Keywords: Green chemistry awareness, entrepreneurial skills, sustainability literacy, innovation intentions, pre-service teachers.

Introduction

The increasing interest on environment protection, climate change, waste management, and green economics around the world has heightened the necessity for educational systems to equip learners with innovative and sustainability-oriented competencies. Education is increasingly becoming an indispensable tool for achieving sustainability by nurturing learners with environmentally conscious attitudes, entrepreneurship capacities, and innovation-oriented mentality to enable learners and



Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idirisu, J. L., Et. al. (2026)

potential professionals is responsible individuals and experts (UNESCO, 2020). In science education and more specifically chemistry education, learning green chemistry concepts has become indispensable because chemical processes and practices exert a profound impact on human health and the environment quality. Green chemistry encourages designing chemical products and processes that use less hazardous chemical substances, reduce waste generation and minimize energy use (Anastas & Warner, 2000). Therefore, teacher training institutions are called to prepare pre-service teachers with awareness, knowledge, skill and literacy on sustainability and innovation for classrooms and communities in the future.

The concept of green chemistry awareness became indispensable learning topic due to its ability to instill environmentally friendly consciousness in both learners and teachers. Green chemistry awareness describes learners or teacher's knowledge and understanding of the application of the environmentally friendly chemical principles designed to reduce pollution and enhance sustainable processes. Growing environmental crisis associated with industrialization, chemical wastes and the non-sustainable ways of life, demands green chemistry to become a global learning priority (Ijioma & Cynthia, 2025). Research has indicated that, teaching green chemistry to science learners enhanced learners' environmental consciousness, thinking and action, and commitment to sustainability (Ijioma & Cynthia, 2025). However, there are lacunas on how green chemistry has been implemented in the schools and tertiary institutions in Nigeria due to limited curriculum integration, lack of instructional resources and poorly prepared teachers (Akinsipo & Anselm, 2025). These suggest the possibility that pre-service teachers might not be aware of the green chemistry principles that can foster innovation. The problem of inadequate environmental sustainability practices in Nigeria has intensified the need for educational reforms that emphasize green and innovative approaches to teaching and learning. Nigeria faces serious environmental issues such as pollution, poor waste disposal systems, deforestation, and climate-related challenges, which require innovative and sustainable responses from citizens and institutions (Anabaraonye et al., 2019). Despite these realities, many teacher preparation programmes still focus predominantly on theoretical instruction with limited emphasis on sustainability-oriented innovation and practical problem-solving skills. Research indicates that many chemistry teachers and pre-service educators demonstrate low understanding and application of green chemistry principles in instructional practices (Owoyemi & Akinde, 2026). The implication is that future teachers may graduate without the competencies necessary to drive environmentally sustainable innovation within schools and society. Therefore, examining the role of green chemistry awareness in shaping innovation intentions among pre-service teachers has become increasingly necessary.

Entrepreneurial skills are another critical variable that influences pre-service teachers' innovation intentions. Entrepreneurial skills are defined as the tangible competencies such as creativity, problem-solving abilities, identification of opportunities, management of risk, and utilization of resources for innovative outputs and viable ventures. Entrepreneurship is no longer business-specific but has taken a central position in science and teacher education, as it encourages self-reliance, creativity and innovativeness (Ugwuanyi & Aderanti, 2023). Acquiring entrepreneurial skills may allow pre-service teachers to produce innovative teaching materials, launch an enterprise that promotes sustainability of the environment, and make contributions to the socio-economic development. In relation to these claims, there is a worldwide trend of education for sustainable entrepreneurship and innovation. In Nigeria, developing entrepreneurial skills has become more relevant as unemployment, poverty and economic recession continue to bite harder. Students



www.foefugusau.com.ng
des@fugusau.edu.ng

DOI: <https://doi.org/10.64348/zije.2026436>

Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idrisu, J. L., Et. al. (2026)

graduating from higher education are finding it difficult to secure a wage job and this is pushing them towards an entrepreneurial pathway that enhances sustainability through the use of innovative approaches (Alao et al., 2023). It is therefore imperative for education institutions to equipped their students with entrepreneurship skills that will enhance innovation and economic sustainability. The result of prior research indicates that acquiring entrepreneurial skills among chemistry and science education students can improve innovation, hands-on skill in problem solving and involvement in the economy sustainably (Nnoli & Udogu, 2021). The result of Ediagbonya et al (2024) indicated that the relationship of sustainable entrepreneurship education on students' Green Entrepreneurial Intention was significant and positive, while it appeared that entrepreneurial skills development are not yet adequately incorporated into some teacher education programs in Nigeria. In the context of education, sustainability literacy is also considered one of the essential factors for the development of innovation intentions. Sustainability literacy is defined as knowledge, values, attitudes and skills, which allow students to make reasoned judgments and decisions, which help in the protection of the environment, justice and the economy (UNESCO, 2020). These competences give individuals the ability to assess global issues and develop new solutions to complex problems. In the case of teachers, it is fundamental, as teachers have the ability to promote the environmental awareness of their students, as well as influence their behaviours and attitudes in a sustainable way. In addition, sustainability literacy will enable future teachers to carry out the sustainable actions they intend to take, and thus guide their students towards innovation and environmental citizenship. While the call for sustainable education has increased at a global level, the level of sustainability literacy among Nigerian students and pre-service teachers appears to be quite low. Reasons may include poorly implemented curricula, ineffective environmental education policies, and insufficient practical experience in education, such as demonstrated by Yahaya (2025) who found that hands-on instruction in sustainability education in Nigerian educational institutions was severely lacking, thus students could not develop competencies in environmental problem-solving. Studies on green chemistry implementation in Nigerian universities found poor awareness, insufficient funding, and lack of adequate reforms in curricula to be the main obstacles to education for sustainability (Akinsipo & Anselm, 2025), which could influence pre-service teachers' innovation intentions in tackling environmental and social problems. Thus, an investigation into the link between sustainability literacy and innovation intentions in pre-service teachers appears warranted.

Innovation intention refers to the propensity, the readiness and the desire of a person to develop, use, or apply new ideas, products, process or practices to help overcome problems and improve the condition of mankind. Innovation intention is one of the key predictors of innovative behaviour as persons who possess good intention are likely to behave creatively and innovatively. In the educational contexts, it is therefore important for pre-service teachers to possess good innovation intention in order to produce innovative teachers who will devise creative pedagogues, change with evolving demands of the educational landscape and champion sustainable development in the nation. The study of the antecedents of pre-service teachers' innovation intention in education seems therefore to be dependent on some educational and psychological factors. These include environmental awareness, entrepreneurial competence and sustainability literacy. The call for an innovative and sustainability-oriented teacher education in Niger State Nigeria is critical given the socio-economic and environmental problems bedevilling the state. These are problems such as unemployment and educational deficits, lack of good management of the environment including waste. The state as an educational hub is seen to be at a crucial junction where there is a demand for more innovative and sustainability-oriented teachers who would initiate and embrace innovative



Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idirisu, J. L., Et. al. (2026)

ways in our classrooms and in their respective communities. Despite the critical position occupied by pre-service teachers' innovation intention in this regard, there seems to be very few empirical studies examining the antecedents of this important factor in Niger State Nigeria. Many studies conducted in Nigeria seem to concentrate in areas such as entrepreneurship education, sustainability practices, green chemistry implementation and each as a standalone variable without linking it with innovation intentions among pre-service teachers. Thus, this research aimed at investigating green chemistry awareness, entrepreneurial skills and sustainability literacy as factors influencing innovation intentions among pre-service teachers in Niger State, Nigeria. This research is anticipated to add to the pool of available literature on the relationship between these variables and also serve as a useful tool for curriculum planners, teacher educators, policymakers, educational institutions on measures to encourage sustainable innovation in teacher training programs.

Objectives of the Study

The main objective of this study was to examine the relationship between green chemistry awareness, entrepreneurial skills, sustainability literacy and pre-service teachers' innovation intentions in Niger State, Nigeria. Specifically, the study sought to:

1. determine the relationship between green chemistry awareness and pre-service teachers' innovation intentions in Niger State, Nigeria.
2. examine the relationship between entrepreneurial skills and pre-service teachers' innovation intentions in Niger State, Nigeria.
3. assess the relationship between sustainability literacy and pre-service teachers' innovation intentions in Niger State, Nigeria.
4. determine the joint relationship of green chemistry awareness, entrepreneurial skills, and sustainability literacy with pre-service teachers' innovation intentions in Niger State, Nigeria.
5. determine the relative contribution of green chemistry awareness, entrepreneurial skills, and sustainability literacy to pre-service teachers' innovation intentions in Niger State, Nigeria.

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

- Ho₁: There is no significant relationship between green chemistry awareness and pre-service teachers' innovation intentions in Niger State, Nigeria.
- Ho₂: There is no significant relationship between entrepreneurial skills and pre-service teachers' innovation intentions in Niger State, Nigeria.
- Ho₃: There is no significant relationship between sustainability literacy and pre-service teachers' innovation intentions in Niger State, Nigeria.
- Ho₄: There is no significant joint relationship among green chemistry awareness, entrepreneurial skills, sustainability literacy, and pre-service teachers' innovation intentions in Niger State, Nigeria.
- Ho₅: Green chemistry awareness, entrepreneurial skills, and sustainability literacy do not significantly contribute relatively to pre-service teachers' innovation intentions in Niger State, Nigeria.

Methodology

This study employed a descriptive correlational survey research design. This design was appropriate because the study aimed to determine the relationship and predictive significance of awareness of green chemistry, entrepreneurial skill and sustainability literacy to pre-service teachers' intention of innovation without manipulating any variable. With the correlational design, the researcher can be able to establish how much joint and relative prediction the independent variables have on



www.foefugusau.com.ng
des@fugusau.edu.ng

DOI: <https://doi.org/10.64348/zije.2026436>

Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idriisa, J. L., Et. al. (2026)

innovation intention of pre-service chemistry teacher. The study was carried out in Niger State, Nigeria. Niger state is located in the North-central geopolitical region in Nigeria. Niger state is also host to various teacher education institutions for the training of science and chemistry teachers. Specifically, the institutions are Dr Umaru Sanda Ahmadu College of Education, Minna and Federal College of Education, Kontagora. The population of the study consists of all final year chemistry education pre-service teachers in teacher education institutions in Niger state, Nigeria. Final year students was considered appropriate since they are the last stage of their training programs and have been subjected to adequate academic and professional training in chemistry education and other subjects in the area of sustainability literacy and entrepreneurship skills. A total of 240 pre-service chemistry teachers were used for the study. A simple random sampling technique was used in selecting the respondents for the study; the choice of this technique assures that each eligible student has an equal chance of being selected. Data were collected for this study using a structured questionnaire titled Green Chemistry Awareness, Entrepreneurial Skills, Sustainability Literacy and Innovation Intentions Questionnaire (GCAESLIQ). The questionnaire had four parts; Part A measured Green Chemistry Awareness, Part B measured Entrepreneurial Skill and Part C measured Sustainability Literacy, while Part D measured Innovation Intentions. The questionnaire items were structured in a 4-point Likert rating scale; Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD), weighted 4, 3, 2, 1 respectively. The items in the instrument were adapted and developed from green chemistry education literature, entrepreneurship education literature, sustainability literacy literature and innovation intention literature. Face and content validity of the instrument were ensured by three experts, two experts in chemistry education and one expert in educational measurement and evaluation. The validity check addressed clarity of wording, relevance and appropriateness of the wording to the subjects in question and relevance to the study objectives. Modifications were made on the questionnaire items based on expert judgments before it was administered to the respondents. A pilot study of the questionnaire was carried out with 30 final year chemistry education pre-service teachers in FCE, Zuba, Abuja, none of which participated in the actual study. This was to ensure the reliability and suitability of the questionnaire. The reliability of the instrument was calculated using Cronbach's Alpha statistical method. The following coefficients of reliability was obtained: Green Chemistry Awareness Scale=0.82, Entrepreneurial Skills Scale=0.85, Sustainability Literacy Scale=0.80 and Innovation Intentions Scale=0.84. The overall reliability coefficient for the instrument was 0.83 which is accepted for an instrument ($e > 0.70$). The questionnaire was administered by the researcher with the help of research assistants to the selected respondents after permission was obtained from management of both institutions. The respondents were informed of the purpose of the study, that their responses are for research and that they are treated with confidentiality. The administration of the questionnaire took six weeks. Data collected were coded and analysed using Statistical Package for the Social Sciences (SPSS) version 25. Pearson Product Moment Correlation (PPMC) was used to investigate the relationships among the variables while multiple regression analysis was used to determine the joint and relative prediction of awareness of green chemistry, entrepreneurial skill and sustainability literacy to innovation intention of pre-service teachers. These inferential statistics were used at 0.05 level of significance. Ethical guidelines were strictly adhered to during the entire period of the study. Participation was voluntary, respondents were informed of their right to withdraw at any time without prejudice, and their responses were kept strictly confidential and only used for research purposes.

Presentation of Results

Hypothesis One



Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idrisu, J. L., Et. al. (2026)

Ho₁: There is no significant relationship between green chemistry awareness and pre-service teachers' innovation intentions in Niger State, Nigeria.

Table 1: Pearson Product Moment Correlation Analysis of Green Chemistry Awareness and Innovation Intentions

Variables	N	Mean	SD	r	p-value	Decision
Green Chemistry Awareness	240	3.12	0.58			
Innovation Intentions	240	3.26	0.61	.621	.000	Rejected

The result presented in Table 1 shows that there is a positive and significant relationship between green chemistry awareness and pre-service teachers' innovation intentions ($r = .621, p < .05$). Since the p-value of .00 is less than the significance level of .05, the null hypothesis was rejected. This implies that green chemistry awareness significantly influences pre-service teachers' innovation intentions in Niger State, Nigeria.

Hypothesis Two

Ho₂: There is no significant relationship between entrepreneurial skills and pre-service teachers' innovation intentions in Niger State, Nigeria.

Table 2: Pearson Product Moment Correlation Analysis of Entrepreneurial Skills and Innovation Intentions

Variables	N	Mean	SD	r	p-value	Decision
Entrepreneurial Skills	240	3.31	0.54			
Innovation Intentions	240	3.26	0.61	.684	.000	Rejected

Table 2 reveals that entrepreneurial skills had a positive and significant relationship with innovation intentions among pre-service teachers ($r = .684, p < .05$). Since the p-value of .000 is less than .05 level of significance, the null hypothesis was rejected. This indicates that entrepreneurial skills significantly influence pre-service teachers' innovation intentions in Niger State, Nigeria.

Hypothesis Three

Ho₃: There is no significant relationship between sustainability literacy and pre-service teachers' innovation intentions in Niger State, Nigeria.

Table 3: Pearson Product Moment Correlation Analysis of Sustainability Literacy and Innovation Intentions

Variables	N	Mean	SD	r	p-value	Decision
Sustainability Literacy	240	3.18	0.57			
Innovation Intentions	240	3.26	0.61	.657	.000	Rejected

The result in Table 3 indicates that sustainability literacy had a positive and significant relationship with innovation intentions among pre-service teachers ($r = .657, p < .05$). Since the p-value of .000 is less than .05 significance level, the null hypothesis was rejected. This means that sustainability literacy significantly influences pre-service teachers' innovation intentions in Niger State, Nigeria.

Hypothesis Four

Ho₄: There is no significant joint relationship among green chemistry awareness, entrepreneurial skills, sustainability literacy and pre-service teachers' innovation intentions in Niger State, Nigeria.

Table 4: Multiple Regression Analysis Showing the Joint relationship between Green Chemistry Awareness, Entrepreneurial Skills, and Sustainability Literacy on Innovation Intentions



Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idirisu, J. L., Et. al. (2026)

Source	Sum of Squares	df	Mean Square	F	R	R ²	Adj. R ²	p-value	Decision
Regression	58.421	3	19.474	48.317	.617	.381	.373	.000	Rejected
Residual	95.118	236	0.403						
Total	153.539	239							

The result presented in Table 4 shows that the joint relationship between green chemistry awareness, entrepreneurial skills, and sustainability literacy on pre-service teachers' innovation intentions was statistically significant, $F_{(3,236)} = 48.317$, $p < .05$. The coefficient of determination ($R^2 = .381$) indicates that 38.1% of the variance in innovation intentions was jointly explained by the three independent variables, while the adjusted R^2 value of .373 indicates the predictive strength of the model after adjustment. Since the p-value of .00 is less than the .05 level of significance, the null hypothesis was rejected.

Hypothesis Five

Ho: Green chemistry awareness, entrepreneurial skills, and sustainability literacy do not significantly contribute relatively to pre-service teachers' innovation intentions in Niger State, Nigeria.

Table 5: Multiple Regression Analysis Showing the Relative Contribution of the Independent Variables to Innovation Intentions

Variables	Unstandardized B	Std. Error	Beta (β)	t	p-value	Decision
Constant	1.214	0.287		4.230	.000	
Green Chemistry Awareness	0.291	0.059	.291	4.962	.000	Significant
Entrepreneurial Skills	0.412	0.060	.412	6.821	.000	Significant
Sustainability Literacy	0.336	0.061	.336	5.474	.000	Significant

The result in Table 5 shows that green chemistry awareness, entrepreneurial skills, and sustainability literacy all made significant relative contributions to pre-service teachers' innovation intentions since their respective p-values were less than .05. Entrepreneurial skills had the highest contribution ($\beta = .412$), followed by sustainability literacy ($\beta = .336$), while green chemistry awareness also contributed significantly ($\beta = .291$). Therefore, the null hypothesis was rejected.

Discussion of Findings

The result of the study identified that there is a significant positive relationship between green chemistry awareness and the pre-service teachers' innovation intentions in Niger State, Nigeria. This means that the greater the knowledge that pre-service teachers possess concerning the practices of green chemistry, the higher the innovation intentions they have. This suggests that the pre-service teachers who possess the knowledge and understanding on environmentally friendly chemical practices are prone to generate ideas and develop sustainable problem solving orientation. This is in consonant with the study conducted by Ijioma & Cynthia (2025) who found that education on green chemistry has influenced student's awareness on environment and critical thinking ability, as well as their sustainable behaviours. This result supports the study of Akinsipo and Anselm (2025) which posited that green chemistry education is instrumental in resolving environmental issues and in promoting innovations in institutions. Also, Owoyemi and Akinde (2026) showed that inadequate knowledge and competence in green chemistry on the part of teachers hindered the implementation of sustainable scientific practice and thus, emphasizes the importance of green chemistry awareness in the enhancement of innovative potentiality. Entrepreneurial skill had a significant positive relationship with pre-service teachers' innovation intentions. This indicates that respondents who



www.foefugusau.com.ng
des@fugusau.edu.ng

DOI: <https://doi.org/10.64348/zije.2026436>

Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idirisu, J. L., Et. al. (2026)

are high in entrepreneurial skills had a higher innovation intention. The implication of this result is that entrepreneurial skills such as creativeness, opportunity seeking, problem solving ability, and need for achievement and independence were instrumental to students' innovation intentions. This result is in accord with the study conducted by Nnoli and Udogu, (2021) who stressed that entrepreneurial skill in chemistry education enhances innovative thinking in chemistry and has led to Nigeria's sustainable development. Also, it aligns with the work of Ugwuanyi and Aderanti (2023) who reported that entrepreneurship-oriented chemistry education is a key strategy to enhance the acquisition of practical skills and entrepreneurial skills among students. In addition, Alao et al. (2023) claimed that entrepreneurial skills development is critical to sustainability and empowerment of students in Nigeria, whereas, Ediagbonya et al. (2024) demonstrated that sustainable entrepreneurship is a significant predictor of entrepreneurial intentions of students. Sustainability literacy significantly and positively correlated with innovation intention among the pre-service teachers. This result means that pre-service teachers who have high sustainability literacy were prone to have higher innovation intentions. It also suggests that sustainability literacy is vital for the development of competencies and capabilities needed for the generation of new ideas, and it equips students with the knowledge, values and attitudes to respond to environmental and social problems in an innovative way. This aligns with the findings of UNESCO (2020) that education for sustainable development is intended to build competencies needed for innovation, responsible actions and decision making. This result supports the study of Yahaya (2025) who opined that sustainability focused education improve student's sustainability competence and problem-solving ability.

The joint influence of green chemistry awareness, entrepreneurial skills, and sustainability literacy on the innovation intentions of pre-service teachers indicated that the three predictor variables explained innovation intentions together significantly. The three predictor variables explain innovation intentions collectively. This suggests that integrating knowledge on sustainability, competencies and green chemistry awareness are important in enhancing innovative potentiality of pre-service teachers. This is in accord with the position of Anabaraonye et al. (2019) who stressed that learning on green entrepreneurship education and sustainability has important role in advancing Nigerian economy, while Ediagbonya et al. (2024) affirmed that sustainable entrepreneurship and related competencies predict students' entrepreneurship intentions. Entrepreneurial skills made a stronger unique contribution to innovation intentions among the pre-service teachers, followed by sustainability literacy and then, green chemistry awareness. This implies that of all the variables examined, the entrepreneurial skills make the greatest unique contribution toward innovation intention of the pre-service teachers. It is believed that the skills in entrepreneurship are practically oriented and help students develop creativity, self-efficacy, innovation and ability to solve problems with less supervision. This aligns with the assertion of Nnoli and Udogu, (2021) that skill development on entrepreneurship through chemistry education is essential for Nigeria's innovative development, and Alao et al. (2023) and Ugwuanyi and Aderanti (2023) argued that entrepreneurial skills is key in empowering students for economic empowerment and sustainability.

Conclusion

From the results obtained, it was found that green chemistry awareness, entrepreneurial skills and sustainability literacy have positive significant relationship with innovation intention of pre-service teachers in Niger state, Nigeria. It was also found in this study that pre-service chemistry teachers with greater green chemistry awareness had greater intention to innovate in the context of solving environment and social issues. The study also found that there is a significant relationship between



Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idirisu, J. L., Et. al. (2026)

entrepreneurial skills and innovation intention, meaning creativity, skills on problem identification, ability to think out-of-box, opportunity recognizing skills were determinants of innovation intention of future teachers. It was also concluded that sustainability literacy has a significant relationship with innovation intentions among pre-service chemistry teachers. This was interpreted that pre-service teachers who know, believe in and are able to act on sustainability education are likely to conceptualize innovative and sustainable ideas. This study also discovered that the variables jointly and independently contributed to innovation intentions, that is to say green chemistry awareness, entrepreneurial skills and sustainability literacy predicted innovation intention but the most powerful predictor was entrepreneurial skills. Hence, this study concluded that, it is very imperative to incorporate sustainability-oriented teaching and learning practices, green chemistry and entrepreneurial skills into teacher education programmes to stimulate innovation intentions of pre-service chemistry teachers in Niger state, Nigeria.

Recommendations

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

1. Institutions involved in teacher education should include principles of green chemistry in chemistry instructions to enable pre-service teachers develop environmental consciousness and innovativeness in their approach to environmental sustainability issues.
2. The importance of an entrepreneurial aptitude in pre-service chemistry teachers' development must be brought into focus by lecturers and curriculum developers, through the promotion of creativity, logical thinking, problem solving and opportunity recognition through practical instruction and activity-based learning environment.
3. Sustainability literacy elements must be integrated into pre-service teacher education programmes through seminars, workshops, projects and hands-on experience opportunities designed to equip students with an environmentally sustainable mindset and innovative solution generation skills.
4. Policymakers and institutional managements in the education sector should make necessary instructional materials, laboratory facilities and training opportunities available that would aid in the efficient delivery and instruction of green chemistry and sustainability concepts.
5. Colleges of education and other teacher education providers must create innovative and entrepreneurship programmes, contests and sustainability initiatives that will serve as a means for pre-service teachers to harness potential innovations and sustainable solutions from a green perspective.

References

- Akinsipo, O. B., & Anselm, O. H. (2025). Challenges and opportunities for implementing green chemistry in Nigerian universities: Educational and policy perspectives. *Sustainability & Circularity NOW*, 2. <https://www.thieme-connect.com/products/ejournals/html/10.1055/a-2534-1903>
- Alao, O. E., Alao, P. O., & Elijah, T. M. (2023). Developing the entrepreneurial skills of Nigerian business education students for sustainability: Policy and practice imperatives. *Contemporary Educational Researches Journal*, 14(4). <https://doi.org/10.18844/cej.v14i4.8965>
- Anabaraonye, B., Okon, O. E., Ewa, B. O., Adeniyi, T. F., & Nwobu, E. A. (2019). Green entrepreneurship education for sustainable development in Nigeria. *Methodology*, 1. <https://pdfs.semanticscholar.org/6c1c/ff67062e1fe8c216c77107d8218f902ab70c.pdf>



www.foefugusau.com.ng
des@fugusau.edu.ng

DOI: <https://doi.org/10.64348/zije.2026436>

Correlation Between Green Chemistry Awareness, Entrepreneurial Skills and ... Idirisu, J. L., Et. al. (2026)

- Anastas, P. T., & Warner, J. C. (2000). *Green chemistry: theory and practice*. Oxford university press. <https://academic.oup.com/book/53104>
- Ediagbonya, K., Edokpolor, J. E., Odibo, G. D., & Sun, J. (2024). Sustainable Entrepreneurship and Business Education Students' Green Entrepreneurial Intention: Does Green Entrepreneurial Self-Efficacy Matters?. *International Business Education Journal*, 17(2), 26-40.
- Ijioma, C. C. I., & Cynthia, C. (2025). The integration of green chemistry principles into chemistry education: a pathway to sustainable industrial practices. *ChemClass Journal*, 9(1), 549-555.
- Nnoli, J. N., & Udogu, M. A. E. (2021). Entrepreneurial Skills for Innovative Chemistry Education: A Panacea for Achieving Nigeria's Sustainable Development. *Journal of Science Education*, 14(2). [Entrepreneurial Skills For Innovative Chemistry Education A Panacea For Achieving Nigerias Sustainable Development](#)
- Owoyemi, T. E., & Akinde, A. A. (2026). Assessment of Green Chemistry Competencies and Training Needs Among Secondary School Chemistry Teachers. *Journal of Research in Environmental and Science Education*, 3(1), 24-45.
- Ugwuanyi, A. A., & Aderanti, M. F. (2023). Enhancing Entrepreneurship Opportunities Through Chemistry Education: Implication For Nigeria Youth Empowerment In The 21st Century: 10.24250/Jpe/2/2023/Aau/Mfa. *Journal Plus Education*, 34(2), 102-114.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). (2020). *Education for sustainable development: A roadmap*. UNESCO Publishing.
- Yahaya, I. B. (2025). Leveraging renewable energy and emerging ICT technologies to build sustainability competencies among secondary school students in Nigeria. <https://doi.org/10.5281/zenodo.18240042>