

ASSESSING THE IMPACT OF RENEWABLE ENERGY EDUCATION ON SECONDARY SCHOOL STUDENTS IN TARABA STATE, NIGERIA

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ABSTRACT

This study assessed the impact of renewable energy education on secondary school students in Taraba state, Nigeria. A survey research design was employed, involving 300 secondary school students (100 from each class level: SS1, SS2, and SS3). The data collected were analyzed using descriptive statistics and ANOVA. The findings revealed that students had a basic understanding of renewable energy concepts, with variations across different classes. However, there was no significant difference in knowledge between male and female students. The study concludes that while students have some awareness of renewable energy, there is a need for more comprehensive and practical education to enhance their understanding and engagement with renewable energy issues. Recommendations include integrating renewable energy education into the core curriculum, providing hands-on learning opportunities, and training teachers on effective teaching strategies for renewable energy concepts.

Keywords: Renewable Energy, Energy Education, Effectiveness and Secondary School

INTRODUCTION

Education is a fundamental component in advancing society towards a cleaner and sustainable energy consumption route. Education is key to advancing a society that can achieve the Sustainable Development Goals (SDGs). To achieve and promote the Sustainable development Goals (SDG's) education will play a pivotal role in creating awareness and promotion of Renewable energy concepts (Hoque, Yasin, & Sopian, 2023). Renewable energy is energy generated from naturally replenishing sources such as wind, sunlight, ocean, biomass, geothermal energy, hydroelectricity and biofuels (Giaconi et al., 2018). They recurrently supply energy sources for agriculture, wireless applications, transportation, heating and cooling, and electricity generation. Renewable energy sources have become important alternatives for nonrenewable energy sources such as fossil fuels (Beken et al., 2019) due to their continual replenishment, cleanliness, environmental friendliness and for decreasing greenhouse gas emissions.

Nigeria has a significant potential for renewable energy, which could ultimately reduce the energy gap between the nation's rural and urban areas (Bamisile et al, 2016), especially in Northern Nigeria. Nigeria is blessed with lots of renewable energy resources like biomass, wind, hydropower, and solar. Biomass potentials in Nigeria is mostly in fuel wood forms, biogas and bio-crops with about 90% of the energy consumption by rural area dwellers is from biomass (Mohamed, 2014). Solar radiation in Nigeria is approximately 3.8×10^{23} kW/day, equivalent to 1,082 million tons of oil. This is vastly greater than the country's daily crude oil and natural gas production, by factors of 4,000 and 13,000, respectively. The annual daily average of the total solar radiation in the coastal region of Nigeria is estimated to be within the range of 12.6MJ/m²/day (3.5 kWh/m²/day), while in the northern region, it is within the range of 25.2MJ/m²/day (7.0 kWh/m²/day). The northern region receives up to 9 hours, compared to 3.5 hours in coastal areas. Covering just 1% of Nigeria's land area with solar modules could generate 1850×10^3 GWh annually, exceeding the nation's current electricity consumption by over 100 times (Humphrey et al., 2022). Hydropower contributes 13% of the nation's electricity via two major plants (Shiroro and Kainji/Jebba). With abundant rivers, waterfalls, and dams, hydropower holds significant potential for expansion.

Biomass energy potential is estimated at 8×10^2 MJ, with 80 million m³ of firewood used annually, primarily for domestic cooking and small-scale industries (Bamisile et al, 2016). Biomass is Nigeria's most utilized renewable energy source, including resources like wood, agricultural, municipal, and industrial waste. Exploitation and the utilization of renewable energy resources and their wide application are essential tools in fighting against global climate change as they could significantly contribute to reducing greenhouse gas emission (Ito, 2017; Revák et al., 2019). Renewable energy resources are increasingly available Nigeria with increasing efficiency with shorter return periods which can be found on the spot.

One Sustainable development Goal is shifting energy consumption from fossil fuels to renewable energy (RE) sources to reduce environmental damage and prevent global warming. Awareness must be instilled among citizens at an early age (as early as secondary school) to motivate students to pursue higher education and careers in renewable energy concepts and technologies (Hoque et al., 2022). Education can meet the growing demand for the renewable energy sector by creating professionals bestowed with specialized knowledge, technical skills in renewable energy supplies, and a commitment to protect the environment.

Education regarding energy issues helps students to be prepared for present and future energy needs. It also enhances the acceptance of the outlook and lifestyle necessary for environmental sustainability (Mehmood, 2021). At the school level, renewable energy concepts are being introduced to various courses as a part of the science curriculum. As asserted by Uddin and Sultana (2024), practical learning is an important and effective strategy to attract student's interest in renewable energy from a very early stage. , practical learning fosters a sense of curiosity to explore energy issues among the students and develop energy knowledge (Morgan, 2019). Along with theoretical inquiry, practical activity-oriented learning initiatives should be developed because they include the design and production of works and prioritize active engagement and participation of students. Studies has revealed a significant lack of curricula on renewable energy concepts in secondary schools, reflecting the low knowledge, interest in, and awareness of renewable energy and its concepts among students (Illias, et al 2020; Hoque et al., 2022; Yasin et al., 2024).

Revák et al. {2019} research, concerns the analysis of the knowledge of students related to renewable energy resources, exploring the differences in the case of students in different grades and also the identification of correlations between the knowledge for renewable energy and some of its influencing factors among secondary school students in Hungary. Results of the study indicate poor and less stable knowledge in the case of every grade. The knowledge structure of the grades is similar, solar, water and wind are the most well-known renewable energy resources. Regarding knowledge, the type of the settlement of residence, education level of parents, school curriculum, textbook, theme weeks, project work, media and internet were important among influencing factors.

Similarly, Bamisile et al. (2016) evaluated renewable energy literacy among senior secondary school students in south-western Nigeria. In order to find out the renewable energy knowledge level in south-western Nigeria, a questionnaire on renewable energy basics is administered to five senior secondary schools in three states. A crosstab correlation of the student's responses is carried out against their school type, fields of study, gender and level of education. According to the response of 225 students, the renewable energy knowledge of the students is about 41.24% which is lower than expected. Hence, it is highly important to equip secondary schools students with necessary information needed to explore, develop, utilize and maximize renewable energy potentials. In this research, the renewable energy knowledge of some students was assessed in some selected schools, in other to validate the usefulness/effectiveness of this study.

Statement of the problem

Energy situation in Nigeria is dreadful, this has led to the dependency on imported oil and gas for decades. Any shortages in the supplies always threaten the stability of the country and potentially stop the country's development. Furthermore, Nigeria is synonymous with an unstable electricity

supply, which is a major threat to the nation. Nigeria is heavily dependent on the national grid for electricity supply which frequently collapse. Nigeria cannot rely solely on the national grid for long-term socio-economic growth and major increases in the standard of living of its residents.

Nigeria has been known for the possession of surplus renewable energy resources particularly in the Northern region. The natural sources of energy regenerate within a short span of time. These energy sources are obtained directly or indirectly from nature and readily available to be utilized for a human being. Such renewable energy resources are solar, wind, biomass, hydro and geothermal. Human beings since ancient time, have attempted to harness these energy sources through different means for their social, economic and environmental benefits. Unfortunately, the awareness of those conditions above, has not been the focus of educators in education institution in Nigeria.

Building secondary school students' awareness of renewable energy, however, may not be as simple as offering the sophisticated knowledge to adults. Improper learning methods, for example, may cause that aspects of knowledge not to be achieved. Instructional guidance on how to disseminate recent findings and inventions in renewable energy are rarely available. As the result, the learning of renewable energy is done conventionally or hardly given to secondary school students. This study fills the gap on the effectiveness of renewable energy education in secondary schools.

Purpose of the study

The purpose this study is to evaluate the Effectiveness of Renewable Energy Education in Secondary Schools in Taraba state. Specifically the study evaluated:

1. the relationship between male and female student's knowledge renewable energy.
2. the relationship between the various classes on student's knowledge renewable energy.

Research Questions

1. What is the mean rating scores of male and female student's knowledge of renewable energy?
2. What is the mean rating scores of the various classes on student's knowledge of renewable energy?

Hypotheses

HO₁: There is no significant relationship between male and female student's knowledge of renewable energy

HO₂: There is no significant relationship between the various classes on student's knowledge of renewable energy

METHODOLOGY

The study adopted a survey research design. The population for the study consist of 5,361 secondary school students from the 43 public secondary schools in Jalingo Education Zone of Taraba State. According to the planning and statistics unit, the population of secondary school teachers in 2023/2024 academic session the population was made up of 2744 females and 2617 males. The sample size comprises 300 students purposively drawn from secondary school offering science subject such as Biology, Chemistry and Physics. 100 students from SS1, 100 students from SS2 and 100 from SS3 to cumulatively form the sample size. Knowledge on Renewable Energy Questionnaire (KREQ) was the instrument used for data collection. KREQ contains 20 items measured on a four-point rating scale to elicit responses, which does not allow the participant to give a neutral answer, as neutral responses will be of no important to the study. The options are Strongly Agree (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagree (SD) = 1 point. KREQ was validated for face and content by three experts, two from the department of Science Education and one from Measurement and Evaluation. The instruments KREQ was subjected to a pilot testing. The instrument was found to have a reliability coefficient

of .71 using Cronbach alpha. Research questions were answered using the descriptive statistic of mean and standard deviation while hypotheses were analysed using ANOVA.

RESULTS

1. What is the mean rating scores between male and female student’s knowledge of renewable energy?

Table 1. Mean Ratings & Standard Deviation Scores between male and female student’s knowledge of renewable energy

S/N	ITEMS	MALE (N = 94)		FEMALE (N = 86)	
		Mea n	SD	Mean	SD
1	Renewable energy is energy generated from naturally replenishing sources	2.55	.969	2.40	.893
2	Renewable energy are resources that are free and convenient to use	2.60	.931	2.49	1.058
3	I am interested in learning more about renewable energy	2.68	.918	2.94	.986
4	Renewable energy resources includes solar, wind and biomass.	3.09	.650	2.86	.946
5	Renewable energy resources that can be converted directly into heat and electricity	2.71	.980	2.40	1.043
6	Learning about renewable energy has influenced my views on energy conservation.	2.93	.779	2.39	.919
7	Renewable energy resources that can be replenished by nature in a short period of time	2.78	.894	2.82	.920
8	Renewable energy is an important topic for environmental sustainability.	2.46	.785	2.76	.900
9	Renewable energy resources that do not produce pollution	2.47	.714	2.25	.890
10	Renewable energy topics make science lessons more engaging.	2.44	.850	2.60	.838
11	My knowledge of renewable energy has increased because of lessons in school.	2.46	.838	2.63	.875
12	Renewable energy resources that are very efficient to use for producing energy	2.50	.773	2.58	.934
13	I understand how renewable energy differs from non-renewable energy sources	2.72	.955	2.92	.715
14	I believe that renewable energy education is important for students.	2.56	.887	2.83	.848
15	I feel that renewable energy can play a major role in solving energy challenges in Nigeria.	2.69	.916	3.01	.857
Grand Mean:		2.64		2.66	

Source: Field Report 2024

Criterion mean: $\bar{x} \geq 2.50$ = Agreed; $\bar{x} < 2.50$ = Disagreed

The results shown in Table 1 reveals that the mean scores of the responses between male and female student’s knowledge of renewable energy. From the table above, male students are more knowledgeable of the fact that renewable energy is energy generated from naturally replenishing sources, are free and convenient to use than their female. Similarly, female students are not knowledgeable of the fact that renewable energy resources that can be converted directly into heat and electricity and learning about renewable energy will bring about energy conservation. Male students to some extent, are not aware that renewable energy is an important topic for environmental sustainability, that renewable energy resources do not produce pollution. More to

that, renewable energy topics make science lessons more engaging. The table reveals from the grand mean which is greater than the criterion mean that both male and female students are having knowledge of renewable energy. The standard deviation scores ranged from 0.650 to 1.058, indicating homogeneity amongst responses and a similar consensus of opinion. The grand mean score of 2.64 and 2.66 for male and female students respectively.

Research question 2: What is the mean rating scores of the various classes on student’s knowledge of renewable energy?

Table 2. Mean Ratings & Standard Deviation Scores of the various classes on student’s knowledge of renewable energy

S/N	ITEMS	SS1 (N = 60)		SS2 (N = 60)		SS3(N = 60)	
		Mean	SD	Mean	SD	Mean	SD
1	Renewable energy is energy generated from naturally replenishing sources	2.58	.979	2.42	.889	2.43	.945
2	Renewable energy are resources that are free and convenient to use	2.50	.948	2.48	.948	2.67	1.068
3	I am interested in learning more about renewable energy	2.85	.917	2.35	.971	3.18	.792
4	Renewable energy resources includes solar, wind and biomass.	2.85	1.005	3.17	.693	2.95	.675
5	Renewable energy resources that can be converted directly into heat and electricity	2.60	.906	2.45	1.064	2.67	1.068
6	Learning about renewable energy has influenced my views on energy conservation.	2.43	.927	2.67	.986	2.97	.663
7	Renewable energy resources that can be replenished by nature in a short period of time	3.07	.800	2.20	.819	3.10	.796
8	Renewable energy is an important topic for environmental sustainability.	2.42	.907	2.43	.890	2.90	.706
9	Renewable energy resources that do not produce pollution	2.27	1.163	2.57	.593	2.27	.446
10	Renewable energy topics make science lessons more engaging.	2.73	1.039	2.38	.865	2.37	.551
11	My knowledge of renewable energy has increased because of lessons in school.	2.40	.867	2.27	.861	2.97	.688
12	Renewable energy resources that are very efficient to use for producing energy	3.03	.843	2.53	.650	2.07	.756
13	I understand how renewable energy differs from non-renewable energy sources	2.70	.869	2.70	.908	3.00	.781
14	I believe that renewable energy education is important for students.	2.77	1.015	2.68	.983	2.63	.551
15	I feel that renewable energy can play a major role in solving energy challenges in Nigeria.	2.70	.830	3.20	.659	2.60	1.061
Grand Mean:		2.66		2.57		2.72	

Source: Field Report 2024

Criterion mean: $\bar{x} \geq 2.50$ = Agreed; $\bar{x} < 2.50$ = Disagreed

The results shown in Table 2 reveals that the mean scores of the responses between male and female student’s knowledge of renewable energy. The table reveals from the grand mean which is greater than the criterion mean that both male and female students are having knowledge of renewable energy. The standard deviation scores ranged from 0.551 to 1.068, indicating homogeneity amongst responses and a similar consensus of opinion. The grand mean score of 2.66, 2.57 and 2.72 for SS1, SS2 and SS3 classes respectively.

HO₁: There is no significant relationship between male and female student’s knowledge of renewable energy

Table 3: ANOVA analysis between male and female student’s knowledge of renewable energy

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.008	1	.008	.138	.710
Within Groups	10.064	178	.057		
Total	10.072	179			

From table 3 above, the ANOVA analysis result revealed that at $F = 0.138$ is not significance at P-value of 0.710 which is greater than 0.05 ($P > 0.05$). This implies that there is no significant relationship between male and female student’s knowledge of renewable energy, therefore the null hypothesis in not rejected.

HO₂: There is no significant relationship between the various classes on student’s knowledge of renewable energy

Table 4: ANOVA analysis between the various classes on student’s knowledge of renewable energy

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.698	2	.349	6.587	.002
Within Groups	9.374	177	.053		
Total	10.072	179			

From table 4 above, the ANOVA analysis result revealed that at $F = 6.587$ is significance at P-value of 0.002 which is less than 0.05 ($P < 0.05$). This implies that there is significant relationship between the various classes on student’s knowledge of renewable energy, therefore the null hypothesis in rejected.

DISCUSSION

Analysis of variance (ANOVA) was conducted to assess the effectiveness of renewable energy education in secondary schools. The findings revealed that, both male and female students have the knowledge of renewable energy. They are aware that renewable energy is energy generated from naturally replenishing sources, are free and convenient to use than their female. The study also revealed that there is no significant relationship between male and female student’s knowledge of renewable energy. The finding of the study agree with the findings of Yasin et al., (2024) study which reveals a remarkable boost in students' interest in pursuing higher education and careers in the renewable energy. However, the findings contradicts with the findings of (Hoque et al., 2022;) which revealed a significant lack of curricula on renewable energy concepts in secondary schools, reflecting the low knowledge, interest in, and awareness of renewable energy and its concepts among students. Finally, the finding this study also revealed a significant relationship between the various classes on student’s knowledge of renewable energy. This implies that students at higher classes (SS3) have more knowledge of renewable energy than does in SS2 and SS1. This is in line with the findings of Revák et al (2019) and Illias, et al (2020) who found that the year of education (class) created a significant difference in the perception towards renewable energy.

CONCLUSION

The above findings and discussions based on the data collected, it is evident to conclude that students are knowledgeable of renewable energy. Although not all of the students had high knowledge of renewable energy, this is a sign of casual/inadequate energy education. The

disparity in this research clearly confirms that energy education is not taught as a separate subject to any gender or a specific class.

RECOMMENDATIONS

Based on the results of this study, it is recommended that:

1. Renewable energy education should be a core part of Nigerian (senior secondary) educational curriculum
2. More attention should be given to technologies and hand on activities to develop and maximize renewable energy potentials in the country.

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KNOWLEDGE ON RENEWABLE ENERGY QUESTIONNAIRE (KREQ)

Personal Information

Please fill in or Tick (√) as appropriate

Sex: Male [] Female []

Class: SS1 [] SS2 [] SS3 []

Instruction

Indicate the degree of your agreement or disagreement to each of the statement below by ticking (√) in the appropriate column.

Key: SA = Strongly Agree (4points), A = Agree (3points), D = Disagree (2points) SD = Strongly Disagree (1point)

S/N	ITEMS	SA	A	D	SD
1	Renewable energy is energy generated from naturally replenishing sources				
2	Renewable energy are resources that are free and convenient to use				
3	I am interested in learning more about renewable energy				
4	Renewable energy resources includes solar, wind and biomass.				
5	Renewable energy resources that can be converted directly into heat and electricity				
6	Learning about renewable energy has influenced my views on energy conservation.				

7	Renewable energy resources that can be replenished by nature in a short period of time				
8	Renewable energy is an important topic for environmental sustainability.				
9	Renewable energy resources that do not produce pollution				
10	Renewable energy topics make science lessons more engaging.				
11	My knowledge of renewable energy has increased because of lessons in school.				
12	Renewable energy resources that are very efficient to use for producing energy				
13	I understand how renewable energy differs from non-renewable energy sources				
14	I believe that renewable energy education is important for students.				
15	I feel that renewable energy can play a major role in solving energy challenges in Nigeria.				