

## Students' Awareness of Natural Radionuclides as a Correlate of Physics Achievement among Senior Secondary School Students in Lagos State

Aluko, T. O\*, Odubanjo, O. F., and Jimoh, O. E.

Department of Physics Education, Federal College of Education (Tech.) Akoka,  
Lagos State toluwisdom@gmail.com; woleodubanjo12@gmail.com;  
joe\_2k1x@yahoo.com

### Abstract

*The ubiquitous nature of natural radionuclides and their potential positive and negative health implications justify examining their awareness. Tracing their pathways and transport mechanism to scientific principles and Physics-related topics, it is essential to investigate the correlation between students' awareness of natural radionuclides as a correlate of Physics achievements among secondary school students. A descriptive survey research design was adopted in this study. The population of the study comprised all SS3 students in Lagos schools around riverine areas and a purposive sampling technique was used to select one hundred and seventy-three (173) SS3 science students of intact classes from five randomly selected schools in Lagos state. Two hypotheses were formulated to guide the study. A researcher-developed research instrument was employed (Natural Radionuclide Awareness Questionnaire (NRAQ) cum Physics Achievement Test (PAT), for the data collection. The data gathered were analyzed using Pearson product-moment correlation and t-test statistics. The result revealed among others that, the level of awareness of students of natural radionuclides is at an average percentage of 53.7, and that there is a positive correlation between students' awareness level of natural radionuclides and their Physics achievement test with ( $r = 0.437$ ,  $n = 173$ ,  $p = 0.000$ ). Based on the findings of this study it was recommended among others that there is a need for more awareness from schools and better methods of teaching physics-related topics to foster a better understanding of their mechanisms which in turn induce behavioral change.*

**Keywords:** Awareness of natural radionuclides, Physics achievement, Potential health risk

### INTRODUCTION

Natural radionuclides are radioactive substances that occur naturally in the environment. They originate from various sources, including cosmic radiation, terrestrial rocks, and soil (Jibiri et al, 2009; Thabayneh & Jazzar, 2012; Hussien et. al, 2023). Examples of common natural radionuclides include uranium, thorium, and radon.

While natural radionuclides are ubiquitous, excessive exposure can pose health risks. Prolonged exposure to ionizing radiation emitted by these radionuclides can increase the risk of cancer and other health problems. This concern has led several researchers to investigate potential health risks in seafood (Kumar & Arunachalam, 2022), surface

water (Ugbede et al, 2020), in the environment near the nuclear plant (Karahan et. al, 2020) in soil, granite, and Charnockite rocks (Isinkaye et. al, 2023). Conversely, radiation has medical applications, such as in cancer treatment through radiotherapy (Zakariya & Kahn, 2014). Awareness of these health implications is essential for students to comprehend the beneficial and hazardous aspects of natural radiation.

Human exposure to natural radionuclides can occur through various pathways, including inhalation, ingestion, and external radiation (Wilson et. al, 2005; Harrad et al, 2020; Domenech & Marcos, 2021). Geographic location, lifestyle, and occupation are possible factors that can influence these exposure levels.

However, radionuclides' transport mechanisms include dispersion in air, water, and soil, and uptake by plants and animals (Harrad et al, 2020; Osmanlioglu, 2022). The knowledge of these principles helps students grasp the dynamics of environmental radioactivity and the need for regulation to protect public health. This scientific background is fundamental for students in physics, as it connects directly to concepts of particle motion, radiation interactions, and environmental science.

Awareness of these natural radionuclides is crucial for students as it contributes to their understanding of physics and related sciences. It develops a sense of responsibility toward environmental health and provides context for radiation in everyday life as in the case of Anjos et. al, (2008), who developed an experimental activity based on the use of traditional and cheap portable Geiger–Müller detectors as survey meters for in situ measurements used to simplify the concept of natural ionizing radiation interaction with the immediate environment among secondary school students. As students learn about radionuclides, they gain a better appreciation of nuclear physics concepts, which can inspire career interests in fields like nuclear science, environmental science, and health physics. However, studies have shown that secondary school students' response to knowledge, awareness, and perception of nuclear energy ranged from no knowledge, little knowledge, low awareness, and significant ignorance when tested in South Africa (Ewin et. al, 2023).

But various aids can enhance students' awareness of natural radionuclides, such as the inclusion of practical demonstrations, field studies, and access to measurement tools like Geiger counters in school laboratories (Anjos et. al, 2008). Additionally, incorporating information on radionuclides in environmental science and physics textbooks and curriculum activities can provide students with hands-on experience and solidify their theoretical understanding (Hans et. al, 2014).

Science students are well-positioned to understand the complexities of radionuclides due to their exposure to fundamental concepts in physics, chemistry, and biology. Physics, in particular, covers essential topics like nuclear decay, radiation, and energy transformations, which are directly relevant to understanding natural radionuclides. This scientific background allows students to engage more deeply with the principles of radioactivity and recognize its applications and implications.

Awareness of radionuclides can enhance students' scientific literacy and this knowledge bridges the gap between abstract scientific theories and real-world applications (Groppi et. al., 2009; Montalbano & Quattrini, 2012), fostering a more comprehensive understanding of physics and empowering students to appreciate the role of science in everyday life. Enhanced awareness also prepares students to address emerging issues related to radiation safety and environmental conservation, making science more relevant and impactful as is the case of Lagos state which has been reported to be a coastal city (LASMEWR, 2021) and therefore prone to radionuclide transport and deposition. Riverine settlements are everywhere along the tips of Lagos Island making flooding a possible agent of natural radionuclide dispersion or deposition in such environments. Issa (2013) and Atibu et. al, (2021) have reported higher natural radionuclide concentrations in riverine sediments and soils hence the need to create awareness of these radionuclides among people in that environment.

#### **STATEMENT OF THE PROBLEM**

Awareness of natural radionuclides is important because of their predominance in the environment particularly in riverine areas where higher concentrations are more reported and for their potential impact on human health. This awareness among senior secondary school students is crucial in shaping students' knowledge of physics concepts, particularly in areas like radioactivity, and nuclear energy, which are integral to the secondary school physics curriculum and related to both natural and anthropogenic activities in these areas. Although several research carried out in secondary schools have focused on how psychological variables related to students' academic achievement, with limited information on research focusing on senior secondary school students' awareness of radionuclides and their influence on students' academic achievement in physics. The knowledge of radionuclides based on Physics principles is expected to be sound among science secondary school students with their teachers applying new teaching and information processes to provide more beneficial learning environments about radiation and radioactivity as recommended by

researchers. The research gap therefore is the concern about whether students are receiving adequate exposure to applied scientific knowledge that should support their academic growth and relationship with their environment.

This study therefore examined the correlation between students' awareness of natural radionuclides and their physics achievement in senior secondary schools in Lagos State. Understanding this relationship could inform curriculum development and teaching strategies, aimed at enhancing students' learning experiences, achievements in physics, and relationship with their environment.

### **PURPOSE OF STUDY**

The purpose of the study was to:

1. Assess the level of awareness of senior secondary school students of natural radionuclides.
2. Determine the relationship between awareness of natural radionuclides and physics achievements among senior secondary school students.
3. Investigate the correlation between awareness of natural radionuclides and physics achievements among senior secondary school students by gender.

### **RESEARCH QUESTIONS**

The following research questions were raised to guide the study:

1. What is the level of awareness of the physics secondary school students of natural radionuclides?
2. What is the relationship between students' awareness of natural radionuclides and their achievements in physics?
3. Is there any correlation between awareness of natural radionuclides and physics achievements among senior secondary school students by gender?

### **RESEARCH HYPOTHESIS**

- i. There will be no significant relationship between students' awareness of natural radionuclides and their achievements in physics.
- ii. There will be no significant correlation between the awareness of natural radionuclides and physics achievements among senior secondary school students by gender.

### **METHODOLOGY**

A descriptive survey research design was used in the study and data was directly collected from senior secondary school students. Senior Secondary III science Students from all senior secondary schools in riverine areas in Lagos state being prone to higher concentrations of radionuclides made up the study population. This set of learners was selected because it is expected that they would have been exposed to almost all the topics in the Physics curriculum for senior secondary school. A purposive sampling technique was applied to select five schools from randomly selected riverine areas in Lagos state, with a sample size of one hundred and seventy-three (173) SS3 science students from intact classes.

A researcher-developed research instrument was employed (Natural Radionuclide Awareness Questionnaire (NRAQ) cum Physics Achievement Test (PAT), for the data collection. The instrument was divided into three sections. The demographic data was the main emphasis of Section A, while Section B contained the awareness prompts and Section C, Physics achievement questions. Both sections B - Students' awareness of natural radionuclides, including their biological effects, was assessed using multiple-choice questions, and section C - Physics Achievement test also contained multiple-choice questions that covered topics in physics such as optics and waves, electromagnetism, and Nuclear Physics. The tools were evaluated by specialists in Science Education to confirm validity, and their criticisms were integrated to improve the quality.

The instrument was pilot-tested among forty students who were not part of the research sample. The reliability of the instrument was done using Cronbach's Alpha scale which gave a moderate value of 0.64. The Statistical Package for Social Science (SPSS) of descriptive and inferential statistics, such as frequency counts, percentages, averages, and correlation, were used to analyze the data collected.

## RESULTS AND FINDINGS

**Research Question 1:** What is the level of awareness of the physics secondary school students of natural radionuclides?

Table 1: Frequency counts and percentages of respondents on their level of awareness of natural radionuclides.

Questionnaire		Frequency	Percentage %
Item One	Incorrect Answer	76	43.9
	Correct Answer	97	56.1
Item Two	Incorrect Answer	144	83.2
	Correct Answer	29	16.8

Item Three	Incorrect Answer	42	24.3
	Correct Answer	131	75.7
Item Four	Incorrect Answer	39	22.5
	Correct Answer	134	77.5
Item Five	Incorrect Answer	106	61.3
	Correct Answer	66	38.2
Item Six	Incorrect Answer	121	69.9
	Correct Answer	52	30.1
Item Seven	Incorrect Answer	63	36.4
	Correct Answer	110	63.6
Item Eight	Incorrect Answer	49	28.3
	Correct Answer	124	71.7
Mean	Incorrect Answer	80.0	46.2
	Correct Answer	92.9	53.7

Table 1 shows the sectional mean percentage score for incorrect answers to be 46.2% and the sectional mean percentage score for correct answers to be 53.7%. This reveals that the level of awareness of the physics secondary school students of natural radionuclides is at an average level. Item one with a percentage of incorrect answers is 43.9% and the percentage of the correct answers is 56.1%, item two with a percentage of incorrect answers is 83.2%, and the percentage of correct answers is 16.8%, item three with a percentage of the incorrect answer is 24.3% and percentage of correct answers is 75.7%, item four with a percentage of the incorrect answer is 22.5% and percentage of correct answers is 77.5%, item five with a percentage of the incorrect answer is 61.3% and percentage of correct answers is 38.2%, item six with a percentage of the incorrect answer is 69.9% and percentage of correct answers is 30.1%, item seven with a percentage of the incorrect answer is 36.4% and percentage of correct answers is 63.6%, item eight with a percentage of the incorrect answer is 28.3% and percentage of correct answers is 71.7%.

## Results

**Hypothesis One:** There will be no significant relationship between the students' awareness of natural radionuclides and their achievements in physics

Table 2: Correlation between awareness test and physics achievement test

		AWARENESS	PAT
AWARENESS	Pearson Correlation	1	.437*
	Sig. (2-tailed)		0.000
	N	173	173
PAT	Pearson Correlation	.437**	1

Sig. (2-tailed)	0.000
N	173

\*\*. Correlation is significant at the 0.01 level (2-tailed).

A Pearson product-moment correlation coefficient was computed to assess the relationship between students' awareness of natural radionuclides and their achievement in physics as shown in Table 2,  $r = 0.437$ ,  $n = 173$ ,  $p = 0.000$ . The performance level of 0.000 is statistically significant meaning that there is a positive correlation between students' awareness of natural radionuclide and their achievements in physics. This implies that a relationship exists between students' awareness of radionuclides and their achievement in physics. Students with a high level of achievement in physics will necessarily display a high level of natural radionuclides awareness in physics and vice versa.

**Hypothesis Two:** There will be no significant difference in the awareness of natural radionuclides and Physics achievement tests among senior secondary school students by gender.

Table 3: T-test comparison of male and female students' awareness of natural radionuclides

Gender	N	Mean	Std. Deviation	t	Df	p-value	Remark
Male	89	43.26	18.264	0.197	171	0.845	Non-significant
Female	84	42.74	16.527				

Table 3 is the result of an independent-sample t-test conducted to compare students' awareness level of radionuclides between male and female students. Male ( $M = 43.26$ ,  $SD = 18.24$ ) and female ( $F = 42.74$ ,  $SD = 16.53$ ),  $t(171) = .197$ ,  $p = 0.845$  at  $\alpha = 0.01$ . This result revealed that the male students had higher mean value than their female counterparts, their mean difference however was not statistically significant ( $t_{\text{calculated}} = 0.197$ ,  $df = 171$ ,  $p > 0.01$ ) and that the observed difference between male and female students' awareness level of radionuclide was not significant, hence the

hypothesis of no significant difference in the awareness of natural radionuclides by gender was accepted.

Table 4: T-test of the variability of male and female student achievements in physics

Gender	N	Mean	Std. Deviation	t	Df	p-value	Remark
Male	89	30.56	14.644	0.091	171	0.928	Non-significant
Female	84	30.075	16.527				

Table 4 shows the result of an independent-sample t-test conducted to compare physics achievements among senior secondary school students by gender. There was no significant difference in the score of males ( $M=30.56$ ,  $SD=14.644$ ) and females ( $F=30.36$ ,  $SD=15.086$ ),  $t(171) = 0.091$ ,  $p = 0.928$  at 0.01. The observed difference in the mean score of the male and female students was not significant. Thus, the hypothesis of no significant correlation between the physics achievements among senior secondary school students by gender is insignificant.

## DISCUSSION OF FINDINGS

The level of awareness of natural radionuclides among senior secondary school III students was revealed to be at an average level with a percentage value of 53.7. This is contrary to a report by Ewin et al (2023) from South Africa that students showed little to no knowledge, low awareness, and significant ignorance of nuclear energy and that the majority of these students had never heard of nuclear energy. Improving the average awareness level as seen in this study may require that a more practical approach be used in disseminating nuclear and radiation topics in line with Imme et. al., (2014) assertion of the enhancement of high school students' awareness of radon risks when involved in radon measurements. Students' awareness was further probed by rating awareness by gender, the results showed no significant difference in the awareness level of the male students to their female counterparts.

However, a positive significant relationship existed between the students' awareness level and their Physics achievement. The implication of this is that the higher the physics achievement, the higher their awareness level, and vice versa. This aligns with the submission of Hans et. al (2014) that the levels of knowledge of radiation are usually



increased with continuous classes on radiation and that this induces positive behavioral changes in the students.

Congruent with the awareness rating between male and female students on natural radionuclides, there was also no significant difference in physics achievement between male and female students. This implies that natural radionuclide physics-related topics are not gender bias and that the instructions can be easily taken by both gender and other factors may be considered to possibly affect students' physics achievement other than gender. This might give an insight into why Anjos et al, (2008) recommended more practical demonstration and use of traditionally made measuring tools to simplify radiation concepts without a mention of gender. Montalbano & Quattrini (2021) and Groppi et al., (2009) also confirmed the potency of hands-on activity to foster scientific interest in nuclear physics application within environmental and physical sciences hence bridging the gap between theoretical knowledge with practical applications.

## **CONCLUSION**

This study has examined the awareness level of secondary school III students of selected secondary schools in Lagos state regarding natural radionuclides and determined the correlation between the students' awareness of natural radionuclides and their achievements in physics. Additionally, it probed further into assessing the contribution of gender to the awareness level and Physics achievements.

## **RECOMMENDATIONS**

Based on the findings of this study, the following suggestions are recommended:

1. The awareness level is still at an average level. Students' awareness level should be better raised for the ubiquitous nature of radionuclides and their potential health implications. Hence a need for more awareness through early education, hands-on activities, and innovative teaching methods in disseminating related topics to foster better information on radionuclides and awareness of their mechanisms.
2. More information and radionuclides-friendly activities should be included in our physics textbooks and curriculum to foster the smooth application of theoretical knowledge of these concepts into real-world situations.

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