



## **Impact of Climate Change on Teaching of Electricity Practicals in Public Polytechnics in Nigeria**

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### **Abstract**

This study examined the impact of climate change on the learning abilities of physics students in their electricity practicals in public polytechnics in Nigeria. The research focused on all students in their second year in the Higher National Diploma (HND 2) in the department of Science Laboratory Technology (SLT) in the physics option, with a sample size of 225 participants selected through purposive sampling method from all the federal polytechnics in Nigeria offering physics at HND 2 in their SLT department of the physics option which comprised 106 males and 119 females. A descriptive survey research design was utilized, employing a self-designed questionnaire titled 'Students Electricity Practical Learning Ability Under Climate Change Teaching Questionnaire' (SEPLAUCCTQ) to gather pertinent information from the respondents. The instrument's validity was confirmed by three experts, two in physics education and one in measurement and evaluation, and its reliability coefficient was measured at 0.86. Research questions were analyzed using frequency counts, percentages, means, and standard deviations, while hypotheses were tested using t-tests at a significance level of 0.05. The study's findings indicated that the climate change influence physics students' learning abilities in electricity practicals. Additionally, there was no significant difference in the effects of climate change on the physics students' learning in electricity practicals based on gender. The conclusion drawn from the study is that climate change factors negatively impact the students learning ability. As a result, recommendations are made for improvement.

**Keywords:** Climate change, Electricity practical, Teaching, learning ability

### **Introduction**

The most significant environmental challenge facing the globe today is climate change. While its causes are global, its impacts are particularly pronounced in developing nations, notably Nigeria. This issue is of great concern worldwide due to the various challenges it presents, which threaten the sustainability of both humanity and the environment (WMO, 2023). The effects can be particularly harsh in underdeveloped and developing countries. Climate change has become a defining reality of our era, bringing alterations in weather patterns that can have dire consequences for people, in education, disrupt seasonal cycles, damage ecosystems and water supplies, impact agriculture and food production, and contribute to rising sea levels. The cumulative impact of climate change affects natural resources and

disrupts the balance of nature, with its consequences already evident in Nigeria. The Intergovernmental Panel on Climate Change (IPCC) working group highlighted that climate change encompasses any alteration in climate over time, whether due to natural variations or human actions (Markkanen & Anger, 2019).

Although climate change has evolved significantly in the past, it continues to progress and will inevitably keep changing (WMO, 2023). These transformations affect not only the quality of life and the environment for current generations but also the survival of humanity in the future. (Cisse, 2019). pointed out that climate change signifies a shift in the world's climate conditions, recognized by scientists and others as predominantly negative. The United

Nations Environment Programme characterized climate change as extreme weather phenomena that adversely affect agricultural resources, water supplies, human health, the depletion of the ozone layer, vegetation, soil, and the doubling of CO<sub>2</sub> levels in the ecosystem (Mann et al, 2017). Mann et al, (2017) described climate change as a shift in climate directly or indirectly linked to human activities, which alters the composition of the global atmosphere along with the natural climate variability observed over similar time frames. Additionally, scientists have exacerbated the greenhouse effect by increasing greenhouse gas concentrations in the atmosphere. WMO (2023) defined climate change as the rise in average global temperatures resulting from both natural events and human activities, which are believed to be contributing to this increase. Climate change is driven by human activities that prioritize immediate needs, often at the expense of future consequences. This phenomenon significantly impacts both individuals and the wider environment. At Nigerian Polytechnic, for instance, climate change has negatively influenced students' learning capacities due to inadequate infrastructure and subpar facilities. Over time, fluctuations in climate have had both direct and indirect effects on students' education. Direct impacts include heightened solar radiation and increased rainfall, which contribute to uncomfortable classroom conditions. Indirectly, when facilities are overused or not properly maintained, learning environments suffer. For example, a classroom designed for fifty students may accommodate eighty, leading to increased heat and carbon dioxide levels, which diminish focus and comprehension in teaching and learning. This overcrowding detracts from the learning experience. According to Monguno & Monguno (2017), any factor—natural or otherwise—that disrupts academic activities and hampers students' learning abilities is detrimental not only to students and educators but also to the socio-economic development of the nation, which relies on effectively trained professionals from higher education institutions. Phan (2021) further noted that mental functions can decline due to thermal discomfort, especially when classroom temperatures vary widely among students during hot seasons. Research indicates that young students are generally supportive of initiatives aimed at mitigating human-induced global warming, with young females displaying greater environmental concern than their male counterparts.

In certain regions, cultural norms can restrict girls to domestic roles while boys attend school. During times of drought, it is often women who bear the burden of water collection, which can hinder their education. Severe drought can lead to food scarcity and hunger, further impacting students' learning. The climate crisis disproportionately affects genders (Johnson & Wilkinson, 2020), and the intertwining of gender and climate change is evident (United Nations, 2021). A study exploring the relationship between patriarchy and women's vulnerability to climate change in Nigeria revealed that cultural norms, which dictate gender roles, heighten women's susceptibility to climate repercussions (Chidiebere, 2019). This traditional division of labor limits women's adaptive capacity to climate change, as they often lack the same freedom as men in choosing how to engage publicly or economically. Consequently, men involved in agriculture can seek alternative livelihoods when climate threats arise, while women may have fewer options due to their domestic responsibilities. This disparity reinforces the patriarchal structures that empower men and hinder women's adaptive capabilities in confronting climate change (Chidiebere, 2019). Additionally, social background plays a crucial role in shaping environmental attitudes (Margaret, 2021). Students in higher education are increasingly engaged with climate change issues and are eager to participate in mitigation efforts (Bainorjie and Ali, 2021). Educators must also be well-informed, as studies suggest that some lecturers lack awareness of climate change (Zhang et al, 2018); (Mann et al, 2017); Ochieng & Koshe, 2013). Furthermore, climate change affects all aspects of life, including education. In Nigeria, particularly in rural areas, heavy rainfall often leads to student absenteeism, as lack of transportation makes it difficult for them to attend school. This absenteeism adversely affects their overall learning capacity. Polytechnic physics Students may face challenges in their learning due to the distance between their accommodations and classrooms, particularly during heavy rainfall. Those living inside polytechnic premises are less likely to miss classes during such weather, as residing on campus can alleviate transportation stress and make it easier for students to attend evening tutorials and study sessions. Conversely, students in remote hostels might miss lectures and important exams, impacting their overall learning experience. There is a growing recognition of how climate change affects educational access and quality. Education, whether formal or

informal, from primary to tertiary levels, plays a vital role in addressing the challenges posed by climate change. It serves as an essential first step toward building resilience (Margaret, 2021).

The United Nations Framework Convention on Climate Change (UNFCCC) emphasizes the importance of education in tackling climate change at various levels, while the Hyogo Framework for Action (HFA, 2005-2015) highlights the need to foster resilience through knowledge and educational initiatives. Additionally, Goal 2 of the Millennium Development Goals (MDG) underscores the significance of primary education in alleviating poverty.

In 2021, many countries experienced numerous climate-related events, including thunderstorms, floods, landslides, and cyclones (Statista, 2021). These events greatly impact the educational achievements of children, particularly those aged 5 to 14. Climate-induced migration hinders access to housing and healthcare, with children facing challenges in obtaining quality education due to language barriers (Hari et al., 2021). Frequent droughts and floods adversely affect school attendance, especially at the primary level (Plan International, 2015). Research shows that climate change negatively influences children's socio-physical environments, prompting the need for effective adaptation strategies to safeguard against its severe impacts (Berse, 2017). This vulnerability can lead to health issues, reduced safety, limited educational access, disrupted recreational activities, and hindered social development (Chatterjee, 2015). According to reports from Zhang et al (2018), children are among the most affected by climate change. The repercussions of severe weather events—such as droughts, floods, and heat waves—directly affect educational access. Over time, gradual environmental changes like rising sea levels, seasonal shifts, desertification, soil erosion, and loss of biodiversity could exacerbate poverty, impacting household spending on education and children's nutritional well-being (Mann et al, 2017). While climate change can have both positive and negative effects, the evidence suggests that its detrimental impacts outweigh the benefits.

During the harmattan season, many students struggle to learn effectively due to the pervasive dust and strong winds. Asthmatic students, in particular, must avoid exposure to dust to prevent triggering health issues (Jamila et al., 2018). Typically, a

classroom designed for fifty students may be adequately utilized during this time. However, slight increases in the number of students beyond fifty can help generate warmth, creating a more comfortable environment for learning. The negative impacts of climate change have both direct and indirect consequences on students' ability to learn. While it is impossible to stop climate change, implementing adaptive strategies can help mitigate its effects on both individuals and the environment.

### Statement of the Problem

Since climate change is increasing over time, its negative effects are being felt in our environment due to an increase in global warming and its related variables or indices, which are closely linked to the environments in which science and technology practicals are taught. This could have an adverse effect on how electricity practicals are taught (WMO, 2023).

The noticeable impact of climate change on students' learning capabilities in public Polytechnics in Nigeria, has raised significant concern in recent times. Despite the administration implementing various measures, it appears that the effects of climate change on students' academic performance have not aligned with the substantial funds invested in these initiatives. In light of this, the study will investigate the influence of climate change on students' learning abilities in public polytechnics in Nigeria in area of electricity practical teaching in physics.

### Research Questions

The study was guided by this research question:

How does climate change impact students' learning abilities in teaching of electricity practicals in public polytechnics in Nigeria?

**Research Hypothesis:** This null hypothesis was developed to direct the study:

There is no significant difference in the impact of climate change on students' learning abilities in teaching of practical physics when considering gender in public Polytechnics in Nigeria.

### Methodology

The research utilized a descriptive survey design to investigate existing relationships within the selected polytechnic context. The study's population included all second-year HND physics students in federal polytechnics in Nigeria, with a sample size of

225 students chosen through purposive sampling method. Data were collected using a self-designed questionnaire named 'Students Electricity Practical Learning Ability Under Climate Change Teaching Questionnaire' (SEPLAUCCTQ) to gather pertinent information from the respondents, which students completed. The SEPLAUCCTQ consists of two sections: Section A gathers demographic information, while Section B focuses on assessing students' learning ability in both their residential locations and under optimal climate conditions. This assessment was based on a Yes or No response scale. The instrument was specifically administered to the selected student participants to evaluate their learning abilities. To ensure that the questionnaire effectively measures its intended constructs, face and content validity were established with the assistance of experts in the researcher's field. The instrument achieved a reliability score of 0.86. Research questions were

analyzed using frequency counts, percentages, means, and standard deviations, while hypotheses testing was conducted using t-tests at a significance level of 0.05. To further validate the reliability of the study, a split-half method was employed, resulting in a correlation coefficient of 0.36, determined via Pearson's Product Moment Correlation Coefficient, also analyzed at the 0.05 significance level. For data analysis, the study applied frequency counts, simple percentages, and chi-square tests.

## Results

To address this question, the responses to items 1-19 in Section B of "Climate Change and its impact on Students Learning Ability in electricity practical (CCISLAEP)" underwent a descriptive analysis. The findings are displayed in Table 1:

**Table 1: Impacts of climate change on students' learning ability in electricity practicals in Nigerian polytechnics**

| S/N | ITEMS   | YES |      | NO |      | REMARK       |
|-----|---|-----|------|----|------|--------------|
|     |   | No  | %    | No | %    |              |
| 1   | I find it easy to do electricity practicals for a long period when the weather is too hot.  | 34  | 27.2 | 91 | 72.8 | Not accepted |
| 2   | I have better learning ability in electricity practicals during harmattan semester than rain semester in the school physics laboratory. | 54  | 43.2 | 71 | 56.8 | Not accepted |
| 3   | My body system is allergic to too cold weather in the school physics laboratory.  | 72  | 57.6 | 53 | 42.4 | Not accepted |
| 4   | Hot weather conditions disrupt my learning ability in electricity practicals.   | 91  | 72.8 | 34 | 27.2 | Accepted     |
| 5   | Rainfall and sunshine condition disturbs me during preparation for physics electricity practical test and examination.                  | 97  | 77.6 | 28 | 22.4 | Accepted     |
| 6   | Inclement weather condition of rainfall, temperature and sunshine affect my learning ability in electricity practicals.                 | 86  | 68.8 | 39 | 31.2 | Accepted     |
| 7   | I always fall sick during school cold weather.  | 67  | 53.6 | 58 | 46.4 | Accepted     |
| 8   | Inclement temperature affect my rate of assimilation in electricity practical Class.  | 78  | 62.4 | 47 | 37.6 | Accepted     |
| 9   | Physics Lecturers come to electricity practical class regularly during harsh weather condition  | 28  | 22.4 | 97 | 77.6 | Accepted     |
| 10  | My school physics classrooms and physics laboratory are conducive enough for teaching and learning electricity practicals.              | 79  | 63.2 | 46 | 36.8 | Accepted     |

|    |   |     |      |    |      |              |
|----|---|-----|------|----|------|--------------|
| 11 | Weather condition reduces my effectiveness in Learning in electricity practicals.                                   | 98  | 78.4 | 27 | 21.6 | Accepted     |
| 12 | Heavy rainfall usually delay students from going to lectures on electricity practicals.                             | 111 | 88.8 | 14 | 11.2 | Accepted     |
| 13 | Physics Lecturers usually waive their electricity practical lectures during heavy rainfall.                         | 101 | 80.8 | 24 | 19.2 | Accepted     |
| 14 | Modern facilities to improve teaching and learning in electricity practicals are available in my school.            | 90  | 72   | 35 | 28   | Accepted     |
| 15 | Heavy down pour usually occur during electricity practical hours in my school.                                      | 75  | 60   | 50 | 40   | Accepted     |
| 16 | My concentration and interest in electricity practicals is high during the heat period.                             | 49  | 39.2 | 76 | 60.8 | Not Accepted |
| 17 | Lack of optimal breeze condition in physics laboratory increases my rate of assimilation in electricity practicals. | 93  | 74.4 | 32 | 25.6 | Accepted     |
| 18 | Too much sunshine negatively affects my rate of assimilation in electricity practicals.                             | 76  | 60.8 | 49 | 39.2 | Accepted     |
| 19 | My learning ability in electricity practicals is affected by the climate and weather condition of the school.       | 89  | 71.2 | 36 | 28.8 | Accepted     |

Table 1 presents the responses regarding the impact of climate change on students' learning abilities. It indicates that 15 out of 19 identified effects are perceived to be linked to climate change. The accepted factors include: hot weather conditions hinder my ability to learn electricity practicals; rainfall and sunlight disruptions interfere with my personal study and exam preparation for electricity practicals; unfavorable weather conditions (such as rain causing coldness, strong winds, or excessive heat) negatively affect my learning of electricity practicals; I frequently get ill during cold weather; extreme temperatures impede my capacity to assimilate information in electricity practical class; physics lecturers consistently attend class during severe weather conditions (like heavy rain or intense sunlight), and our classrooms are generally conducive to teaching and learning electricity practicals. Additionally, weather conditions diminish my learning effectiveness in electricity practicals; heavy rain often delays physics students from attending lectures in electricity

practicals or going to school; physics lecturers may cancel electricity practical classes during heavy rain; modern teaching electricity practical facilities are available at my school; heavy downpours frequently coincide with electricity practical lecture times; inadequate air circulation hampers my ability to absorb information in electricity practicals; high levels of sunlight decrease my learning effectiveness in electricity practical; and my learning ability in electricity practicals is influenced by the overall climate and weather conditions at the school physics laboratory.

To test this hypothesis, the responses to items 3 from Section A and items 1-19 from Section B of "Climate Change and public polytechnic physics Student Learning Ability (CCPPSLA)" regarding the impact of climate change on learning ability in teaching electricity practicals were analyzed statistically using a t-test at a significance level of 0.05. The results are displayed in table 2 below:

**Table 2: t-test Analysis of differences in impacts of climate change on polytechnic physics student learning ability in electricity practicals based on gender**

| Gender | N   | Mean   | Std. D | Df  | T     | p-value |
|--------|-----|--------|--------|-----|-------|---------|
| Male   | 106 | 21.655 | 3.925  | 223 | 1.387 | 0.168   |
| Female | 119 | 28.433 | 4.252  |     |       |         |



The findings presented in Table 2 demonstrated that there was no significant difference in the mean scores of male physics students ( $M = 21.655$ ,  $SD = 3.925$ ) compared to female physics students ( $M = 28.433$ ,  $SD = 4.252$ ;  $t = 1.387$ ,  $p = .168$ ). Consequently, the null hypothesis was not rejected, as the  $p$ -value of 0.168 exceeded the 0.05 significance level. In other words, gender did not play a significant role in the effects of climate change on physics students' learning abilities.

### Discussion of the Findings

The findings indicate that climate change impacts students' learning capabilities during the studied period in electricity practicals. This suggests that various climate-related factors, such as extreme heat disrupting students' learning, rainfall and sunlight affecting their study and test preparation, and adverse weather conditions (like rain causing coldness or excessive heat) hinder effective learning in electricity practicals. Additional considerations include illness during cold weather and unfavorable classroom conditions that impair assimilation rates in electricity practicals. Furthermore, attendance may be affected as physics lecturers might not hold electricity practical classes during severe weather events such as heavy rainfall or intense sunlight, which can also reduce students' learning effectiveness. Instances of torrential rain often delay students from reaching school, and electricity practical classes are frequently canceled during such downpours. The intense sunlight further diminishes students' ability to assimilate information in electricity practicals.

However, there is no significant difference in how climate change affects students' learning abilities in electricity practicals based on gender. Therefore, the observed gender differences at the Nigerian Polytechnics, do not correlate with students' learning performance in electricity practicals. This finding contradicts the assertions of Johnson & Wilkinson (2020) and Chidiebere (2019), with the former suggesting a strong link between learning ability and gender as a predictor of climate change effects, while the latter argued for a negative correlation between learning ability and gender. This conclusion agrees to the analysis by Plan International (2015), which noted that frequent droughts and floods significantly affect school attendance, particularly at the primary level.

### Conclusion

This study concludes that climate change adversely affects the learning abilities of polytechnic physics students in electricity practicals in Nigeria. This indicates that various climate change factors hinder physics students' capacity to learn electricity practicals. Furthermore, it was found that there is no direct correlation between gender and physics students' learning abilities in electricity practicals in polytechnics under climate change condition.

### Recommendations

In light of these findings, the following recommendations are proposed: - Educate physics lecturers about the impacts of climate change on students' learning abilities in electricity practicals, and inform them of their potential roles in raising awareness among physics students and the polytechnics about this issue.

The Federal Ministry of Education should implement awareness programs, including workshops, seminars, and conferences, aimed at polytechnic physics students across Nigeria to enhance their understanding of climate change and its implications for learning electricity practicals.

The Ministry of Education should support further research to deepen the understanding of how climate change affects the learning abilities of tertiary physics students in Physics practicals in Nigeria.

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