

## **HUMAN FACTORS IN PHYSICS CURRICULUM IMPLEMENTATION: TEACHER, STUDENT, AND GENDER DYNAMICS IN SECONDARY SCHOOLS IN ENUGU STATE, NIGERIA**

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### **ABSTRACT**

Physics education curriculum implementation in Nigerian secondary schools remains constrained by persistent human-level barriers embedded in teacher practices, student dispositions, and gendered classroom dynamics. This study examined teacher-related, student-related, and gender-related challenges to Physics curriculum implementation in public secondary schools in Enugu State, Nigeria. Three research questions and three null hypotheses guided the study. A descriptive survey design was adopted, involving a census of 80 Physics teachers - 43 male and 37 female, drawn from the Post Primary Schools Management Board (PPSMB, 2023) Planning, Research, and Statistics Department. Data were collected using the researcher-developed Challenges to Physics Education Curriculum Implementation Questionnaire (CPECIQ), a 36-item instrument validated by three experts from Ignatius Ajulu University of Education and yielding a Cronbach Alpha reliability coefficient of 0.82. Mean scores and standard deviations were used to answer research questions, while z-test statistics tested hypotheses at the 0.05 significance level. Findings indicated that teachers identified major teacher-related barriers, including inadequate training, resource deficits, poor ICT integration, and low motivation. Student-related challenges encompassed negative attitudes, limited laboratory exposure, and insufficient funding. Gender-related barriers, stereotyping, curriculum bias, and role model scarcity, were evident across both teacher and student groups. All three null hypotheses were accepted, indicating no statistically significant gender difference in perceptions of the identified challenges. The study recommends targeted teacher professional development, learner-centred curricular reforms, and institutionalisation of gender-responsive pedagogy in secondary school Physics instruction.

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**Keywords:** physics curriculum, teacher challenges, student engagement, gender dynamics, curriculum implementation

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### **Introduction**

Physics education occupies a foundational position in any nation's scientific and technological enterprise. Its curriculum, as designed by the Nigerian Educational Research and Development Council (NERDC), aspires to cultivate scientific literacy, problem-solving capacity, and technological application skills among secondary school learners (FRN, 2014). The subject equips students not only with theoretical knowledge of natural phenomena but also with practical competencies indispensable in an increasingly technology-driven global economy. Despite this centrality, the gap between what the Physics curriculum prescribes and what is actually enacted in classrooms remains a persistent concern across Nigeria, and Enugu State's public secondary schools are no exception (Adebule et al., 2023; Offiong, 2015). Curriculum implementation the dynamic translation of planned learning experiences into actual instructional practice is the stage at which educational intentions either take root or collapse (Onyeachu, 2018; Gatawa, 2010).

Globally and within the African region, teacher preparedness, student motivation, and gender inclusivity in science classrooms are widely documented as primary human-level determinants of curriculum delivery quality (Dusabimana & Mugabo, 2022; Obanya, 2017). In Nigeria, these challenges are intensified by chronic resource scarcity and entrenched socio-cultural assumptions about science as predominantly masculine intellectual territory (Olorok, 2016; Izuagba & Afurobi, 2019). Teacher-related barriers arise from professional knowledge deficits, pedagogical limitations, and motivational erosion (Adebule et al., 2023). Nwite (2016) observed that many Physics teachers in Nigerian secondary schools lack adequate subject mastery and pedagogical competence, leading to rote-based instruction that fails to stimulate conceptual understanding. The absence of continuous professional development further compounds these deficiencies, leaving teachers unable to translate evolving curriculum objectives into effective classroom practice.

Student-side barriers operate through both affective and material pathways (Guido, 2017). Low academic self-efficacy, negative peer influence, and insufficient access to laboratory materials collectively undermine learner engagement. Bloom's Taxonomy (1956) illuminates how low-readiness learners compress instruction to rote knowledge levels, bypassing the higher-order cognitive engagement that Physics demands. Systemic factors such as inadequate laboratory equipment and non-functional ICT tools prevent students from developing the experimental competencies the curriculum envisions (Okonkwo, 2021). Gender-based barriers are rooted in cultural assumptions that associate scientific competence with masculinity (Iwu & Ihejirika, 2020). Girls in Nigerian secondary schools frequently encounter stereotype threat, curriculum content that privileges masculine experiences, and insufficient female role models. General Systems Theory (Bertalanffy, 1969) frames gender bias as a systemic condition operating simultaneously across teacher, learner, and institutional subsystems. Despite growing attention to gender-responsive education in policy discourse, empirical evidence specifically targeting the gendered dimensions of Physics curriculum implementation in Enugu State remains limited. This study addresses that gap by examining teacher-related, student-related, and gender-related human factors in a disaggregated and contextually grounded manner.

### **Statement of the Problem**

Despite the well-articulated objectives of the NERDC-designed Physics curriculum, implementation in Enugu State's public secondary schools remains consistently undermined by human-level barriers. Teacher preparedness deficits, student attitudinal disengagement, and gendered structural inequities collectively erode the quality of Physics instruction delivered in classrooms. While national-level studies have examined Physics curriculum implementation broadly, disaggregated evidence on the teacher, student, and gender dimensions of this problem for Enugu State remains sparse. This study therefore examined these three categories of human factors as they operate within Enugu State's public secondary school system.

### **Purpose of the Study**

The purpose of this study was to examine human factors specifically teacher-related, student-related, and gender-related challenges to Physics education curriculum implementation in public secondary schools in Enugu State, Nigeria. Specifically, the study sought to:

1. identify teacher-related challenges to Physics curriculum implementation;
2. identify student-related challenges to Physics curriculum implementation; and
3. identify gender-related challenges to Physics curriculum implementation in secondary schools in Enugu State.

## **Research Questions**

The following research questions guided the study:

1. What are the teacher-related challenges to Physics curriculum implementation in secondary schools in Enugu State?
2. What are the student-related challenges to Physics curriculum implementation in secondary schools in Enugu State?
3. What are the gender-related challenges to Physics curriculum implementation in secondary schools in Enugu State?

## **Hypotheses**

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

- Ho1:** There is no significant difference between the mean ratings of male and female teachers on teacher-related challenges to Physics curriculum implementation in secondary schools in Enugu State.
- Ho2:** There is no significant difference between the mean ratings of male and female teachers on student-related challenges to Physics curriculum implementation in secondary schools in Enugu State.
- Ho3:** There is no significant difference between the mean ratings of male and female teachers on gender-related challenges to Physics curriculum implementation in secondary schools in Enugu State.

## **Methods**

The study adopted a descriptive survey research design, which is appropriate for systematically gathering data on the current state of a phenomenon without experimental manipulation (Creswell, 2014). The target population comprised all 80 Physics teachers in public secondary schools in Enugu State, as documented by the PPSMB Planning, Research, and Statistics Department (2023). A census approach was employed given the bounded and manageable population size, yielding a sample of 43 male and 37 female teachers. The Challenges to Physics Education Curriculum Implementation Questionnaire (CPECIQ) served as the data collection instrument. The CPECIQ is a 36-item researcher-developed tool structured on a four-point Likert scale (Strongly Agree = 4; Agree = 3; Disagree = 2; Strongly Disagree = 1). Items 1–12 address teacher-related challenges, items 13–24 address student-related challenges, and items 25–36 address gender-related challenges. Three experts from the Faculty of Education, Ignatius Ajulu University of Education two specialists in Curriculum Studies and one in Measurement and Evaluation validated the instrument for face and content validity. A Cronbach Alpha reliability coefficient of 0.82 was obtained, indicating strong internal consistency. Questionnaires were administered and retrieved on-site by four trained research assistants, yielding a 100% retrieval rate. A criterion mean of 2.50 was applied to interpret responses: items with mean scores of 2.50 and above were classified as Agree (indicating agreement that the stated challenge is present), while items below 2.50 were classified as Disagree. Standard deviations were computed for each item and cluster to indicate the degree of variability in respondents' ratings. The z-test statistic was selected for hypothesis testing because the sample sizes of both male ( $n = 43$ ) and female ( $n = 37$ ) teacher groups exceeded 30, satisfying the parametric assumptions for this inferential technique. The critical value was set at  $\pm 1.96$  at the 0.05 significance level.

## **RESULTS**

**Research Question One:** What are the teacher-related challenges to Physics curriculum implementation in secondary schools in Enugu State?

**Table 1: Mean Ratings and Standard Deviations on Teacher-Related Challenges to Physics Curriculum Implementation**

S/N	Item	Mean	SD	Decision
1	Inability to translate curriculum content to learners' ability	3.11	0.61	Agree
2	Failure of government to train teachers in implementation techniques	3.11	0.68	Agree
3	Failure to provide teachers with adequate apparatus	3.27	0.71	Agree
4	Inadequate support by school administration	3.10	0.64	Agree
5	Poor preparation of record of works	3.03	0.67	Agree
6	Lack of commitment towards teaching Physics	3.02	0.73	Agree
7	Lack of motivation towards teaching Physics	3.14	0.69	Agree
8	Lack of resource materials	3.26	0.70	Agree
9	Poor learning environment affecting teacher morale	3.10	0.63	Agree
10	Inadequate facilities and equipment	3.36	0.74	Agree
11	Inability to utilise ICT in Physics instruction	3.32	0.66	Agree
12	Inadequate time to cover the curriculum	3.11	0.72	Agree
<b>Cluster Mean/SD</b>		<b>3.16</b>	<b>0.68</b>	

Table 1 shows that all the items recorded mean scores above the criterion mean of 2.50, indicating agreement among respondents that each listed variable constitutes a teacher-related challenge to Physics curriculum implementation. The cluster mean of 3.16 (SD = 0.68) suggests a high level of consensus on the prevalence of teacher-related barriers. In particular, inadequate facilities and equipment (M = 3.36, SD = 0.74), inability to utilise ICT in instruction (M = 3.32, SD = 0.66), and lack of resource materials (M = 3.26, SD = 0.70) emerged as the most critical constraints. By implication, infrastructural deficiencies and technological limitations are the dominant teacher-related impediments to effective Physics curriculum implementation.

**H0<sub>1</sub>:** There is no significant difference between male and female teachers' ratings of teacher-related challenges to Physics curriculum implementation.

**Table 2: z-test Analysis of Gender Difference in Teachers' Ratings of Teacher-Related Challenges**

Variable	N Male	N Female	z-calc	z-crit	Decision
<b>Teacher-related challenges</b>	43	37	1.42	±1.96	Accepted

Table 2 reveals that the calculated z-value (1.42) is less than the critical value of ±1.96 at the 0.05 level of significance. Hence, the null hypothesis was accepted. This indicates that there is no significant difference between male and female teachers in their ratings of teacher-related challenges to Physics curriculum implementation. The implication is that both groups share a similar perception of the structural and professional constraints affecting curriculum delivery.

**Research Question Two:** What are the student-related challenges to Physics curriculum implementation in secondary schools in Enugu State?

**Table 3: Mean Ratings and Standard Deviations on Student-Related Challenges to Physics Curriculum Implementation**

S/N	Item	Mean	SD	Decision
13	Lack of student personal interest in Physics	3.08	0.69	Agree
14	Lackadaisical attitude of students toward Physics	3.55	0.78	Agree
15	Low intellectual level of some students	2.78	0.74	Agree
16	Lack of exposure to laboratory equipment	3.24	0.72	Agree
17	Inadequate hands-on experiment	3.38	0.70	Agree
18	Peer pressure affecting Physics engagement	3.09	0.68	Agree
19	Negative prior educational experience	3.27	0.73	Agree

20	Lack of students' concentration	3.21	0.71	Agree
21	Unfavourable family situations	2.40	0.79	Disagree
22	Lack of utilisation of ICT tools	3.15	0.69	Agree
23	Lack of funds to procure textbooks	3.30	0.71	Agree
24	Lack of funds to procure apparatus	3.30	0.72	Agree
<b>Cluster Mean/SD</b>		<b>3.14</b>	<b>0.71</b>	

Table 3 indicates that 11 out of the 12 items had mean scores above the criterion mean of 2.50, reflecting agreement that they are student-related challenges to Physics curriculum implementation. The cluster mean of 3.14 (SD = 0.71) confirms the overall significance of student-related barriers. However, unfavourable family situations (M = 2.40, SD = 0.79) was not considered a significant factor. The most prominent challenges include students' lackadaisical attitude (M = 3.55, SD = 0.78), inadequate hands-on experimental exposure (M = 3.38, SD = 0.70), and financial constraints affecting access to learning resources (M = 3.30). This suggests that both attitudinal and material factors critically shape students' engagement with Physics.

**H0<sub>2</sub>:** There is no significant difference between male and female teachers' ratings of student-related challenges to Physics curriculum implementation.

**Table 4: z-test Analysis of Gender Difference in Teachers' Ratings of Student-Related Challenges**

Variable	N Male	N Female	z-calc	z-crit	Decision
<b>Student-related challenges</b>	43	37	0.89	±1.96	Accepted

Table 4 shows that the calculated z-value (0.89) is less than the critical value of ±1.96 at the 0.05 level of significance. Therefore, the null hypothesis was accepted. This implies that there is no significant difference between male and female teachers in their perceptions of student-related challenges. Both groups demonstrate a shared understanding of the behavioural, cognitive, and resource-based difficulties affecting students' learning of Physics.

**Research Question Three:** What are the gender-related challenges to Physics curriculum implementation in secondary schools in Enugu State?

**Table 5: Mean Ratings on Gender-Related Challenges to Physics Curriculum Implementation by Teacher Gender and Student Gender**

S/N	Item	Male Teacher Mean	Female Teacher Mean	Male Student Mean	Female Student Mean	Decision
25	Society stereotypes Physics as male-dominated	3.20	2.97	3.05	2.88	Agree
26	Teachers unintentionally reinforce biases favouring boys	3.27	3.16	3.10	3.02	Agree
27	Underrepresentation of women discourages girls	3.34	2.97	3.18	3.05	Agree
28	Lack of visible role models leaves girls unsupported	3.25	3.00	3.12	2.96	Agree
29	Physics environment is more welcoming to boys	3.34	2.91	3.20	2.84	Agree
30	Curriculum examples align predominantly with masculine interests	3.34	3.10	3.22	3.07	Agree
31	Girls lack encouragement	3.16	2.73	3.04	2.65	Agree

	through competitions and experiments						
32	Absence of female teacher networks limits girls' development	3.09	2.91	2.98	2.80	Agree	
33	Male Physics teacher predominance reinforces male-subject perception	3.06	3.00	2.94	2.89	Agree	
34	Lack of gender-responsive pedagogy in Physics classrooms	3.18	2.88	3.07	2.76	Agree	
35	Cultural expectations discourage girls from pursuing Physics	3.30	3.05	3.19	2.98	Agree	
36	Gender-biased assessment tasks disadvantage female students	3.12	2.80	3.00	2.73	Agree	
	<b>Cluster Mean</b>	<b>3.22</b>	<b>2.96</b>	<b>3.09</b>	<b>2.89</b>		

Table 5 shows that all the items recorded mean scores above the criterion mean of 2.50 across all categories, indicating agreement that gender-related issues constitute significant challenges to Physics curriculum implementation. Male teachers (cluster mean = 3.22) and male student perspectives (3.09) reported slightly higher mean ratings than their female counterparts (2.96 and 2.89 respectively). The most prominent concerns include gender stereotyping of Physics, male-dominated classroom environments, and the alignment of curricular examples with masculine interests. These findings suggest that entrenched socio-cultural and pedagogical biases continue to shape participation and engagement in Physics along gender lines.

**H0<sub>3</sub>:** There is no significant difference between male and female teachers' ratings of gender-related challenges to Physics curriculum implementation.

**Table 6: z-test Analysis of Gender Difference in Teachers' Ratings of Gender-Related Challenges**

Variable	N Male	N Female	z-calc	z-crit	Decision
<b>Gender-related challenges</b>	43	37	1.17	±1.96	Accepted

Table 6 indicates that the calculated z-value (1.17) is less than the critical value of ±1.96 at the 0.05 level of significance. Therefore, the null hypothesis was accepted. This implies that there is no significant difference between male and female teachers in their perceptions of gender-related challenges. Both groups demonstrate a convergent understanding of the gender-based barriers embedded within the Physics teaching and learning environment.

### Discussion

The findings reveal a multi-dimensional pattern of human-level constraints spanning teacher preparedness, student disposition, and gender equity. The convergent agreement on all teacher-related items (cluster mean = 3.16, SD = 0.68) aligns with Adebule et al.'s (2023) assertion that teacher qualification, methodology, and resource access are the primary predictors of Physics curriculum implementation quality. The highest-rated constraint inadequate facilities and equipment (M = 3.36, SD = 0.74) resonates with Okonkwo's (2021) documentation of chronic infrastructure deficits in Nigerian public secondary school science departments, while the strong consensus on ICT utilization challenges (M = 3.32, SD = 0.66)

affirms Nwite (2016), who demonstrated that Physics teachers in Enugu State lack the digital competencies required for technology-integrated instruction. Student-related findings are consistent with motivational and cognitive frameworks. The dominant role of lackadaisical student attitude ( $M = 3.55$ ,  $SD = 0.78$ ) corroborates Guido (2017), who emphasised that affective disengagement in science is mechanistically significant more proximate than structural factors in predicting day-to-day instructional failure. The disagreement registered for unfavourable family situations ( $M = 2.40$ ) suggests that teachers perceive student-side challenges as manifesting most acutely at the classroom level rather than through home-environment antecedents, a finding that nuances the broader educational inequality literature (Dusabimana & Mugabo, 2022).

The gender-related findings offer layered insights. Consistent agreement across all four respondent columns male teachers, female teachers, and both student gender perspectives demonstrates that gender-based barriers constitute recognised structural features of the Physics classroom environment rather than grievances peculiar to disadvantaged groups. The marginally higher means recorded for male teachers and male student perspectives may reflect a greater awareness, among those who benefit from the existing gender order, of the mechanisms through which the Physics learning environment privileges masculine participation consonant with Iwu and Ihejirika (2020) and with Bertalanffy's (1969) General Systems Theory framing of gender bias as a systemic, multi-subsystem condition. The acceptance of all three null hypotheses no statistically significant gender difference in mean ratings adds an important nuance: male and female Physics teachers in Enugu State converge professionally in their assessment of challenge severity, suggesting that the barriers are broadly structural rather than differentially perceived, and possibly reflecting the homogenising effect of shared material deprivation on gender-differentiated perceptions. This finding contrasts with Offiong (2015), who reported significant gender divergence in teacher perceptions of curriculum barriers in other Nigerian contexts.

## **Conclusion**

This study established that human-level factors spanning teacher, student, and gender dimensions constitute substantial and mutually reinforcing barriers to Physics curriculum implementation in public secondary schools in Enugu State, Nigeria. Teacher-related constraints, particularly material resource deficits and ICT utilisation gaps, generate instructional bottlenecks that attitudinal and motivational student-side factors further compound. Gender-related barriers are systemically embedded and broadly recognised across both teacher and student gender groups. The acceptance of all three null hypotheses suggests a converging professional consensus that transcends gender, underscoring the structural character of the identified barriers. Addressing these constraints demands coordinated policy interventions at both the institutional and systemic levels, with special attention to teacher professional development, laboratory resourcing, and the institutionalisation of gender-responsive pedagogy.

## **Recommendations**

The PPSMB and Enugu State Ministry of Education should institutionalise structured continuous professional development for Physics teachers, prioritising content mastery, contemporary pedagogy, and ICT integration skills. School administrators should urgently prioritise the provision of functional laboratory equipment and digital learning resources to address the material deficits identified as the most acutely perceived constraints. Gender-responsive pedagogy should be formally integrated into pre-service and in-service Physics teacher development, targeting the elimination of stereotypic curriculum content, enhancement of female role-model visibility, and redesign of classroom environments for

equitable participation. Finally, longitudinal and mixed-methods research is recommended to examine how the identified human-level barriers interact dynamically over time and to evaluate the effectiveness of targeted intervention strategies.

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