International Journal of Social Science Research (IJSSR)
Volume- 2, Issue- 4 | July - August 2025 ISSN: 3048-9490

Exploring Pedagogical and Learner Challenges in Higher Secondary Physics Education

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Abstract

The effective teaching and learning of physics at the higher secondary level remain a critical concern in many regions of India, particularly in geographically and socio-culturally diverse areas such as the East Khasi Hills district of Meghalaya. This exploratory study investigates the pedagogical challenges faced by teachers and the learning difficulties experienced by students in higher secondary physics classrooms across selected schools in the district. Using a descriptive survey method, data were gathered through scale on challenges of teaching and learning physics' involving 66 physics teachers and 170 students from both government and private schools. Findings indicate that teachers face significant constraints including insufficient laboratory infrastructure, inadequate training in modern pedagogical techniques, language barriers, and heavy syllabi for both male and female teachers and teachers belongs to urban and rural areas. These findings are vital for policymakers, curriculum designers, and educators aiming to enhance the quality of science education in Meghalaya and similar contexts.

Keywords: Physics Education, Pedagogical Challenges, Higher Secondary Students, Learning Barriers.

Introduction

Understanding human development necessitates having a solid understanding of science, which has a special place in education. However, university and upper secondary students consider science, especially physics, to be the most challenging subject (Mulhall, McKittrick, & Gunstone, 2001). Most significantly, science lectures are generally regarded as dull or overly abstract (Osborne, Simon, & Collins, 2003), and students consistently perform worse in physics than in chemistry and biology (Rebello & Zollman, 2004). Most students report having little interest in science in general and physics in particular, which has an impact on grades. (Assem and others, 2023). According to Abaniel's (2021) research, students' engagement in scientific learning and comprehension of scientific concepts have improved when teachers use inquiry-based learning. Consequently, effective physics mastery of both subject matter and teaching techniques are necessary for instruction, and in order for students to succeed, they should be motivated to actively participate and collaborate with their teachers (Shulman, 1986).

This study set out to investigate the difficulties that higher secondary physics instructors and students face when instructing and learning the subject. Senior secondary physics is especially challenging for teachers and students because it necessitates the integration of abstract ideas with mathematical applications (Mulhall, McKittrick, & Gunstone, 2001). The goal of the study is to assist educators by identifying the main pedagogical obstacles that prevent physics

instruction from being delivered effectively, particularly in higher education settings where a solid foundation is crucial. Thus, the objective of the current study is to comprehend the particular obstacles that educators and learners encounter in Meghalaya's East Khasi Hills District, a region with distinct educational, linguistic, and infrastructure contexts that affect the results of physics education.

Review of related literature

According to Kaya and Boyuk (2011), the majority of physics instruction in classrooms is theoretical, which affects how students feel about the subject. They discovered that more students had unfavorable opinions about physics than had favorable ones. Furthermore, students' opinions on physics classes and lab experiments did not significantly differ based on their gender. Despite curriculum guidelines that encourage hands-on demonstrations, Banu (2011) found that physics instruction frequently relied on a transmissive teaching style. Practical work was difficult for both teachers and students, especially in private (non-government) schools, which had more problems than government schools. High student-teacher ratios and a lack of lab assistants were contributing factors, which made teaching more difficult.

According to Somuah et al. (2013), there aren't many differences between the difficulties science teachers in urban and rural areas encounter when instructing integrated science. Disparities in access to and support for professional development opportunities were observed, though, between teachers in urban and rural areas. According to Tee-Oon and Subramaniam (2023), attitudes toward physics were similar among male and female students. Negative opinions from peers and parents deterred students' interest in the subject, despite the fact that teachers generally encouraged them to pursue it. The perceived complexity of the subject was further increased by its conceptual difficulty and mathematical requirements. According to Ryngksai (2013), students had poor mathematical foundations and had trouble with the English language. An extensive syllabus, the abstract nature of the subjects, and the mathematical applications involved were additional obstacles to successful science learning. Students' interest in science subjects declined as a result of time constraints that also made learning more difficult. According to the gender of their physics teachers, Awodun, Oni, and Oyeniyi (2015) looked into how well students performed. According to their study, there was a significant difference in achievement scores between students taught by male and female teachers, with the former performing better.

Methodology

Research Design

This study employed a descriptive survey design to explore the pedagogical and learner challenges faced in higher secondary physics education. The design was chosen as it facilitates the collection of both qualitative and quantitative data, allowing for a comprehensive understanding of the issues from the perspectives of both teachers and students.

Participants

The target population consisted of higher secondary physics teachers and students from government and private schools across urban and rural regions. A stratified random sampling technique was used to ensure representation across gender, teaching experience, and school locality. A sample 66 teachers and 170 students were selected for the study.

Tools for Data Collection

Two structured research instruments were used:

1. **Scale on Challenges towards Physics Teaching and Learning (SCPL)**

The scale has 60 items and based on Likert-scale format (Strongly Agree to Strongly Disagree). The scale was divided into two part including teachers and students. First 3o items for teachers and remaining is for students. Items covered aspects such as curriculum difficulty, use of teaching aids, conceptual understanding, mathematical integration, time constraints, and classroom engagement. The instruments were reviewed by a panel of experts in physics education and educational psychology to ensure **content validity**. A **pilot study** was conducted with 60 teachers and 70 students to refine item clarity and reliability. The internal consistency of the scale was confirmed using **Cronbach's alpha** ($\alpha = 0.82$ for teachers, $\alpha = 0.79$ for students).

Analysis and interpretation

*Table 4.1: Mean differences in challenges faced by teachers in teaching physics at the higher secondary level in government and Private schools***.**

Group	N	Mean	SD	S. E_d	t-ratio	Level of sig
Government	32	122.5	1.91	1.765	0.797	N.S.
Private	34	121.00	3.32			

Table 4.1 presents the mean challenge scores of higher secondary physics teachers from government and private schools, recorded as 122.5 and 121.0, respectively. The corresponding standard deviations are 1.91 for government and 3.32 for private school teachers. The computed t-value of 0.79 falls below the critical threshold of 1.96 at the 0.05 level of significance. This indicates that the observed difference in challenge levels between the two groups is not statistically significant. Therefore, it can be inferred that physics teachers in both government and private institutions face comparable challenges. Nonetheless, the slightly elevated mean score among government teachers suggests they may experience marginally greater difficulties than those in private schools.

Table 4.2: Difference in the Challenges Faced by Male and Female Higher Secondary School Teachers in teaching physics

Group	N	Mean	SD	$S.E_d$	t-ratio	Level of significance
Male	35	120.61	3.43	1.38	0.28	Not Sig.
Female	31	121.00	1.41			

Table 4.2 reveals that male and female higher secondary physics teachers have mean challenge scores of 120.61 and 121.00, respectively, with standard deviations of 3.43 for males and 1.41 for females. The calculated t-value of 0.28 is lower than the critical value of 3.18 at the 0.05 significance level, indicating that the difference between the two groups is not statistically significant. This suggests that both male and female teachers encounter similar challenges in teaching physics. Nonetheless, the marginally higher mean score among female teachers points to a slightly greater level of difficulty faced by them in comparison to their male peers.

Table 4.3: Mean difference in Challenges Faced by Urban and Rural Higher Secondary School Teachers in teaching physics.

Group	N	Mean	SD	$S.E_d$	t-ratio	Level of sig.
Urban	32	120.83	3.24	2.28	0.365	Not Sig
Rural	34	120.00	3.6			

Table 4.3 shows that higher secondary physics teachers in urban areas have a mean challenge score of 120.08, while those in rural areas have a mean score of 120.00. The standard deviations are 3.24 for urban teachers and 3.60 for rural teachers. With a computed t-value of 0.36, which does not reach statistical significance at any conventional level, there is no substantial difference in the challenges reported by teachers based on geographical location. However, the marginally higher mean score for urban teachers may indicate they experience slightly more challenges than their rural counterparts.

Table 4.4. Difference in the challenges faced by higher secondary school students in learning physics in government and private institutions.

Group	No. of students	Mean	Standard Deviation	$S.E_d$	t-ratio	Level of sig.
Government	80	112.96	2.23	0.249	2.59	.01

Private	90	113.80	2.29			

Table 4.4 indicates that higher secondary students from government schools have a mean score of 112.96 for challenges in learning physics, while students from private schools have a slightly higher mean score of 113.80. The standard deviations are 2.24 for government school students and 2.29 for those in private institutions. The calculated t-value of 3.59 exceeds the critical value of 1.97 at the 0.05 significance level, demonstrating a statistically significant difference between the two groups. This finding suggests that students in private schools encounter more challenges in learning physics than their counterparts in government schools, as evidenced by their higher average score.

Table 4.5 Significance difference in the challenges faced by male and female higher secondary students in learning physics.

Group	**No. of students**	**Mean**	**Standard Deviation**	**S.E$_d$**	**t-ratio**	**Level of significance**
Male	100	113.51	2.40	0.196	0.869	Not Sig
Female	70	113.68	2.37			

Table 4.5 indicates that the mean scores for challenges in learning physics among higher secondary students are 113.51 for males and 113.68 for females, with standard deviations of 2.40 and 2.37, respectively. The calculated t-value of 0.869 is below the critical value of 1.96 at the 0.05 level of significance, indicating that there is no statistically significant difference between male and female students in terms of the challenges they face in learning physics. However, the slightly higher mean score for female students suggests they may experience marginally more difficulties than their male peers.

Table 4.6: Significance difference on the challenges faced by higher secondary school students in learning physics in urban and rural areas.

Group	**No. of students**	**Mean**	**Standard Deviation**	**S.E$_d$**	**t-ratio**	**Level of significance**
Urban	80	13.59	2.41	0.27	0.35	Not Sig.
Rural	90	113.69	2.14			

Table 4.6 shows that the mean scores for challenges in learning physics among higher secondary students are 113.59 for those in urban areas and 113.69 for those in rural areas, with

standard deviations of 2.41 and 2.14, respectively. The computed t-value of 0.354 is less than the critical value of 1.98 at the 0.05 level of significance, indicating no statistically significant difference between the two groups. However, the slightly higher mean score for rural students suggests they may face marginally greater challenges in learning physics compared to their urban peers. Therefore, it can be inferred that students in rural areas encounter more learning difficulties in physics than those in urban areas.

Discussion and conclusion

Another significant issue that surfaced was how students perceived physics. The abstract and mathematical nature of the subject (Ryngksai, 2013), parental and peer discouragement, and a lack of sufficient foundational knowledge in mathematics and English are some of the reasons why a sizable percentage of students have negative attitudes toward the subject (Kaya & Boyuk, 2011; Tee-Oon & Subramaniam, 2023). Time constraints and overburdened curricula, which provide little opportunity for concept reinforcement or individualized attention, further aggravate these perceptions (Ryngksai, 2013).

Interestingly, research did not find gender or location-based differences in perceptions and challenges (Kaya & Boyuk, 2011). The effect of teacher gender on student performance male teachers are linked to higher student achievement in physics is a distinctive finding of Awodun, Oni, and Oyeniyi's (2015) study. This finding necessitates more thorough research and poses significant queries regarding the dynamics of teacher-student interactions and teaching effectiveness.

A comprehensive approach that includes curriculum reform, teacher preparation, better resource allocation, and initiatives to make physics more interesting and approachable for all students is needed to address these issues. Students' conceptual understanding and attitudes toward physics can be improved through a focus on hands-on learning, differentiated instruction, and encouraging learning environments.

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