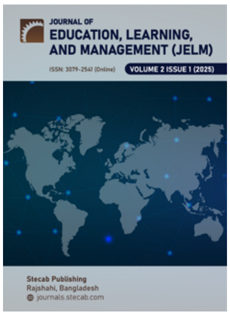

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Research Article

Factors Affecting Teaching and Learning of Physics in Ghanaian Senior High Schools: Study in the Greater Accra Region

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About Article

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ABSTRACT

This study aimed to examine the factors affecting the teaching and learning of Physics in Ghanaian Senior High Schools. Purposive and convenient sampling techniques were used to sample the teachers and students. The sample size for this study was 50 teachers and 300 students. Descriptive statistics, such as percentages, means, and standard deviations, were used to analyse the data. The findings revealed that demonstration and discussions to illustrate concepts/ phenomena, emphasising qualitative thinking and presentation of concepts, laying emphasis on mathematical presentation of concepts/ students planning and doing their experiment, teacher demonstration of problem-solving on the whiteboard, and teaching and learning being teacher-centred are the main teaching approaches of physics in senior high schools. The main constraining factors of teaching and learning physics in senior high schools were inadequate professional physics teachers, inadequate laboratory equipment, students' perception of physics, an inadequate number of physics teachers, and students finding physics too mathematical and challenging. With regards to the way forward, it was identified from the teachers' responses that there should be better salaries and/or incentives for physics teachers, there should be more teacher professional development on physics practicals, and training of more graduate teachers must be encouraged and supported. The responses of the students indicated that appropriate authorities should provide adequate laboratory equipment, and there should be more training for physics teachers. The study concluded that due to the important nature of the subject, it is important for stakeholders in education to come together to find modern ways of teaching the subject and also address critical challenges such as inadequate laboratory equipment and professional development of teachers, among others.

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1. INTRODUCTION

The advancement and use of science and technology are acknowledged as essential to a nation's development efforts. Science and its applications in the workplace and industry are the foundation of a nation's progress, and skilled labourers and citizens require a solid grasp of science and mathematics (Anamuah-Mensah, 2004). As a result, science education is essential in Ghana to provide the trained labour force and human resources required to run our domestic industries. Without studying physics, science, and technology would never have a deeper knowledge. This is because physics is defined as an age-old branch of science that examines everything from common phenomena to fundamental philosophical issues, from the smallest particles in nature to the furthest galaxies, and from sophisticated satellites to bodily functions (Angell *et al.*, 2004). As the foundation for engineering, technology, and other physics-related subjects, physics education is consequently essential in schools, colleges, and universities. Therefore, students with a background in physics are required to approach new problems with a high degree of precision and correctness and to reason both inductively and deductively. Since physics depends on logic and mathematical ideas, students studying physics should cultivate critical thinking skills.

Furthermore, physics is regarded as being crucial to the advancement of science, technology, and the economy (Phys TEC, 2014). Physics Education Research (PER) empirical studies have provided fundamental recommendations for the physics curriculum that are widely acknowledged and thought to expand students' physics knowledge and comprehension (Ogundokun & Adeyemo, 2010; Buabeng *et al.*, 2015). It seems that fewer and fewer students in Ghana are choosing to major in physics these days. Both the tertiary and senior high levels have this predicament. There has been a recent increase in the number of students pursuing physics at those levels due to the Free Senior High School Program. They seem to have a conflicted attitude regarding physics, nevertheless.

This claim is also recognised as a global concern about the number of graduates who wish to become physics instructors and the number of students who pursue physics at the secondary and university levels (PhysTEC, 2014). According to the National Task Force on Teacher Education in the United States, there is a larger need for qualified physics instructors now than there has ever been (PhysTEC, 2014). Some institutions have closed their physics departments due to the subject's decline (Blickenstaff, 2010). The belief that physics is a challenging subject with low student achievement, the idea that physics is highly mathematical and abstract, and the way the subject is taught in high school could all be contributing factors to the decline in the number of students enrolled in physics. Pockley (2013) details the steps taken in Australia by physicists to stop the "worrisome decline" in the number of students pursuing physics. It would not be out of the question to hypothesise that several factors, including teaching methodology, teacher credentials, teacher education programs, instructional resources, attitudes of both teachers and students toward physics, psychosocial learning environments, and teaching and learning support systems, are responsible for this concerning development. Vannier (2012) states that several reports on Ghanaian classroom practices and student performance have highlighted certain areas of concern, such as a lack of hands-on science activities, little time dedicated to the subject, teachers lacking confidence in their ability to teach science, and students showing little interest in the subject.

Therefore, it would be interesting to look into problems related to physics education and learning. When these problems are fixed and educators modify how they teach physics, students are assisted in overcoming their unfavourable opinion of the subject. The student may then become interested in it. Thus, the purpose of this study was to look into how physics is taught and learned in senior high schools in Ghana.

2. LITERATURE REVIEW

The effectiveness of physics instruction in Ghanaian schools is significantly influenced by the calibre of the teachers. About 40% of Ghanaian physics teachers are underqualified, and many of them teach subjects unrelated to their specialisations, according to Buabeng *et al.* (2018). This shortage is particularly acute in the Greater Accra Region, where qualified physics professors are usually lured to higher-paying private universities or non-teaching industries (Agyei & Voogt, 2016). Acquiring pedagogical content knowledge is challenging even with official credentials. Taale (2013) claims that while many physics teachers in Accra schools possess a strong theoretical understanding, they struggle to connect concepts to practical applications and deliver interactive presentations. This content delivery has a significant impact on students' engagement and comprehension of fundamental physics concepts.

Inadequate laboratory facilities and equipment severely hinder physics instruction in most senior high schools in Ghana. Just 17% of the 24 schools in Greater Accra had functional physics labs with enough supplies, per a survey by Babb & Stockero (2020). Teachers are compelled to use more theoretical teaching methods as a result of this shortage, depriving students of crucial opportunities for experiential learning.

Ghana's physics curriculum has come under fire for emphasising theoretical knowledge over practical applications. The curriculum is overly test-focused and still prioritises memorisation over conceptual understanding. Teachers in Accra schools claim they feel pressured to "teach to the test" rather than develop students' ability to solve problems or think scientifically (Donkor, 2021). Methods of assessment exacerbate these issues. According to Mensah (2023), assessment methods still heavily favour recall-based questions over ones requiring critical thinking or practical application. This misalignment between educational goals and assessment practices discourages teachers from using innovative teaching techniques that could boost student engagement.

Students' perceptions of physics as "abstract" or "difficult" present significant learning barriers. According to a study by Morgan and Aboagye (2022), out of 400+ students in Greater Accra, about 65% said that physics was hard and unrelated to their future careers. These negative perceptions are often the consequence of poor training methods and limited exposure to practical applications. Gender differences complicate the learning environment. Appiah-Twumasi (2018) discovered significant gender differences in physics enrolment and performance in Accra schools, with female students accounting for less than 30% of physics classes. These disparities are caused by cultural norms, a dearth of female role models in STEM fields, and teaching methods that inadvertently reinforce gender stereotypes.

Language proficiency has a significant impact on physics instruction because English is the main language of instruction in Ghanaian senior high schools. Owu-Ewie and Eshun (2015) discovered that language barriers make teaching abstract physics concepts very challenging, particularly for students from households where English is not a common language. This issue affects conceptual understanding and complex terminology, particularly in schools that cater to the diverse socioeconomic backgrounds of Greater Accra. Class sizes and teaching loads are major obstacles at the system level. According to Amoako (2020), public schools in Greater Accra had an average of 45–60 students in physics classes, which is much more than what is recommended for good science instruction. These large classes also make it logistically difficult to conduct laboratory sessions securely, and the quality of physics instruction is heavily influenced by administrative assistance and school leadership.

3. METHODOLOGY

For this investigation, a quantitative methodology was used. A quantitative approach enables the researcher to quantify and extrapolate the research findings to the full population, provided that the sample is well chosen, claim Creswell and Creswell (2017). The research utilised a cross-sectional survey approach, which guarantees that data is gathered from participants at a specific moment in time (Sedgwick, 2014). It also enables the researcher to get additional information and statistics on the respondents. Ghana's Greater Accra Region is included in the study. This area was chosen since it is home to multiple senior high schools. The study focused on physics teachers and students at senior high schools in the Greater Accra Region. The accessible population was selected based on categories. The categories are A, B, and C schools. Each school was selected from the categories A, B, and C, respectively. Therefore, the target population for the research focused on all physics teachers and final-year physics students in Frafraha Community Senior High School (Category C), Ghanata Senior High School (Category B), and Accra Girls Senior High School (Category A). Survey questions, both open-ended and closed-ended, were utilised to get quantitative information from the participants. One effective technique to collect data from a large number of respondents in a short amount of time is through the use of survey questionnaires. There were two sets of questionnaires created: one for teachers and one for students. There were four sections on these two different questionnaires. The respondents' demographic details were covered in the first section. The teachers' methods of instruction were covered in the second segment. The third consists of restricting elements of teaching and learning physics. The future direction of physics education was covered in the fourth section.

The Ghana Education Service (GES), more especially the Greater Accra Regional Education Office, which is in charge of all educational operations in the area's senior high schools, provided ethical clearance before data collection could begin. Formal consent was requested from the headmasters or headmistresses of participating schools following regional approval. This strategy guarantees institutional cooperation and respects Ghana's educational system's administrative structure. A comprehensive description of the study's goals, methods, time commitment, possible risks and rewards, confidentiality protocols, and their right to leave without repercussions was sent to all physics teachers taking part. Direct consent is required for students who are 18 years of age or older. Along with student assent forms, parental/guardian consent forms were obtained for anyone under the age of 18. These documents were presented in plain, uncomplicated English.

Descriptive statistics such as percentages, means, and standard deviations were used to analyse the data. The study's main goal was to identify and characterise the factors influencing physics instruction and learning in the senior high schools of Greater Accra, and descriptive statistics give clear representations of the prevalence, intensity, and distribution of these factors, directly addressing the research objectives (Taale, 2013). By focusing on developing a comprehensive understanding of the educational context rather than testing specific causal hypotheses, descriptive measures like frequencies, percentages, means, and standard deviations provide easily comprehensible insights into the educational landscape that educational stakeholders can easily interpret. Physical resources, human factors, institutional policies, and sociocultural components are some of the factors that impact physics education. Without requiring the strict assumptions frequently required for inferential analysis, descriptive statistics enable the simultaneous investigation of these disparate variables (Agyei & Voogt, 2016). Understanding the practical size of issues (such as student-textbook ratios and laboratory equipment availability percentages) is more useful for educational policy and practice in Ghana than statistical significance levels. Descriptive statistics readily present these useful aspects (Owu-Ewie & Eshun, 2015). Comparable educational studies in Ghana have successfully used descriptive methodologies to inform educational policy and practice (Appiah-Twumasi, 2018; Donkor, 2017), and the current research phase benefits more from the rich contextual understanding that descriptive analysis provides than from inferential statistics, which would be useful for testing specific hypotheses about causal connections or establishing generalisable relationships.

4. RESULTS AND DISCUSSION

Male Teachers made up the bulk of respondents (84%) compared to women, who made up 16% of the sample. In terms of age, Table 1 shows that eight respondents, or 16% of the sample, were between the ages of 21 and 30; 24 respondents, or 48% of the sample, were between the ages of 31 and 40; 13 respondents, or 26% of the sample, were between the ages of 41 and 50; and five respondents, or 10% of the sample, were 51 years of age and above. Regarding qualifications, a large percentage of respondents (52%) held postgraduate degrees (PhD, M.Sc., or M.Ed., and 19 had first-degree degrees (BSc. or BA.), 8 had first-degree degrees in education (B.Ed.), and 4 had postgraduate diplomas (Table 1). In terms of years of experience, 44% of the respondents had taught for six to ten years; six respondents, or 12% of the total, had taught for three to five years; twelve respondents, or 24% of the total, had taught for eleven to fifteen years; two respondents, or 4% of the total, had taught for one to two years; and eight respondents, or 16% of the total, had taught for fifteen years (Table 1).

Table 1. Characteristics of physics teachers (N = 50)

Characteristic	Frequency	Percentage
Gender		
Male	42	84.0
Female	8	16.0
Age		
21 – 30	8	16.0
31 – 40	24	48.0
41- 50	13	26.0
51 years and above	5	10.0
Qualification		
PhD/M.Sc/M.Ed	26	52.0
1st Degree (BSc/BA)	12	24.0
1st Degree (Ed.)	8	16.0
Post Graduate Diploma	4	8.0
Diploma	0	0
Years of Experience		
<1year	0	0
1 – 2	2	4.0
3 – 5	6	12.0
6 – 10	22	44.0
11 – 15	12	24.0
Above 15 years	8	16.0

Source: Field Survey (February 2022)

Table 2 shows that 67.0 per cent of the respondents were men and 33.0% were women. Age-wise, the data indicates that 85% of the respondents were in the 15–19 age range. Eight per cent of the respondents, or 24, are between the ages of 20 and 24. The results also show that two respondents, or 1.0% of the sample, were older than 25 years old, while 18 respondents, or 6.0% of the sample, were between the ages of 10 and 14.

Table 2. Bio-data of students respondents (N = 300)

Characteristic	Frequency	Percentage
Gender		
Male	202	67.0
Female	98	33.0
Age		
10 – 14	18	6.0
15 – 19	256	85.0
20- 24	24	8.0
25 years and above	2	1.0

Source: Field Data (February, 2022)

4.1. Teaching approaches

The results of the teaching methods are shown in Table 3. The data in the table indicate that most of the sample's teachers used discussions and demonstrations more frequently to explain ideas and phenomena in their physics lessons. This is reflected in the 3.86 mean score. Additionally, the vast majority of educators embraced student-centred learning (3.80). Many educators placed a strong emphasis on how topics are presented mathematically and how students design and carry out their experiments (3.80). Also, the majority of the study's professors placed a strong emphasis on qualitative thinking and concept presentation (3.76).

Many teachers occasionally help students work through physics problems on their own (3.74); others allow students to describe their thoughts (3.74); still others help students follow directions from the teacher (3.70). The results also showed that most teachers offer new materials on a whiteboard or model problem-solving on one (3.68) and that many teachers occasionally make teaching and learning teacher-centred (3.70). More teachers help students work in groups on physics problems (3.68); most teachers involve students in activities that are based on context (3.62). Based on the statistics, it seems that educators give their lessons by best practices for their pedagogical techniques.

Table 3. Teaching approaches to physics

	Percentage responses					
Statement on Teaching Approaches	**N**	**R**	**S**	**A**	**Mean**	**Std. dev**
How often do you use teaching and learning materials	0	12.0	22.0	66.0	3.54	0.70
I demonstrate problem-solving on the whiteboard	0	6.0	20.0	74.0	3.68	0.58
I emphasise the mathematical presentation of concepts	0	14.0	18.0	68.0	3.54	0.73
I emphasise qualitative thinking and presentation of concepts	0	6.0	12.0	82.0	3.76	0.55
I use demonstrations and discussions to illustrate concepts/ phenomena	0	4.0	6.0	90.0	3.86	0.58
Teaching and learning are teacher-centred	0	8.0	14.0	78.0	3.70	0.61

Teaching and learning are student-centred	0	8.0	4.0	88.0	3.80	0.57
I engage students in context-based activities	0	4.0	30.0	66.0	3.62	0.56
Students work with physics problems individually	0	6.0	14.0	80.0	3.74	0.56
Students work with physics problems in groups	0	10.0	12.0	78.0	3.68	0.65
Students have the opportunity to explain their ideas	0	6.0	14.0	80.0	3.74	0.56
Students experiment by following the instructions from the teacher	0	6.0	18.0	76.0	3.70	0.45
Students plan and do their experiment	0	8.0	14.0	88.0	3.80	0.57

Source: Field Survey (February 2022)

4.2. Students' perspectives on teaching approaches

The percentages, mean scores, and standard deviations of the students' answers to instructional aspects, such as effective physics instruction and learning, are displayed in Table 4. Individual physics problem-solving assistance was provided to students (3.72), and many students received assistance in organising and carrying out their experiments. A few students were able to articulate their thoughts (2.67). Others believed that the teacher should be at the centre of teaching and learning (2.66) and that the most crucial teaching strategies were when the teacher presented new materials on a whiteboard, with a mean score of 2.66. With a mean score of 2.66, students in the study prefer to conduct experiments by following their teacher's instructions, with most students occasionally. Instructors can occasionally make learning and instruction more student-centred (2.61). Teachers helped students select the topics they wanted to research (2.59); Teachers employed talks and demonstrations to explain ideas and phenomena (2.50). Students want to see the instructor emphasise learning new material and involve them in activities that are context-based (2.40); they also want to see the instructor incorporate student ideas and suggestions into the lesson (2.40).

The data also showed that students worked in groups to solve physics issues (2.29); it seems that students in the sample don't always grasp the methods physics lecturers employ to teach their subjects.

Table 4. Students' perspective on teaching approaches

Statements on teaching	**Percentage Responses (300)**					
	N	**R**	**S**	**A**	**Mean**	**Std.Dev**
The teacher presents new materials on the whiteboard	0.0	11.0	43.0	46.0	2.66	0.67
Teacher demonstrating problem-solving on the whiteboard (e.g. solving examples of physics problems)	0.0	12.0	12.0	76.0	3.64	0.69
The teacher emphasises the mathematical problem-solving of new concepts	0.0	2.0	43.0	55.0	2.59	0.55
Teacher emphasises the understanding of new concepts (qualitative thinking)	1.0	48.0	51.0	0.0	2.50	0.52
The teacher uses demonstrations and discussions to illustrate concepts/ phenomena	4.0	41.0	55.0	0.0	2.50	0.56
Teaching and learning are teacher-centred	0.0	11.0	43.0	46.0	2.66	0.67
Teaching and learning being student-centred	0.0	7.0	47.0	46.0	2.61	0.62
Teachers using students' suggestions and ideas in teaching	8.0	45.0	47.0	0.0	2.40	0.63
Teacher engaging students in context-based activities	13.0	36.0	51.0	0.0	2.40	0.70
The teacher guides students to work on physics problems individually	0.0	6.0	16.0	78.0	3.72	0.57
The teacher assists students in working with physics problems in groups	0.0	15.0	39.0	43.0	2.29	0.74
The teacher allows students to explain their ideas	0.0	8.0	41.0	51.0	2.67	0.61
The teacher assists students in choosing their topics to investigate	0.0	2.0	43.0	55.0	2.59	0.55
Doing experiments by following instructions from the teacher	0.0	11.0	43.0	46.0	2.66	0.67
Teachers guide students to plan and do their experiments	0.0	6.0	16.0	78.0	3.72	0.57

Source: Field Data (February, 2022)

4.3. Teachers constraining factors

The percentages, mean scores, and standard deviations of the instructors' answers to the items about the characteristics that limit the quality of physics instruction and learning are displayed in Table 5. A significant proportion of educators perceived insufficiently experienced physics instructors as a limiting factor in physics instruction (mean score: 3.98); similarly, most teachers considered insufficient lab supplies to be a limiting factor in physics instruction (mean score: 3.88); The data also shows that teachers believed that parental and societal views about physics' difficulty and lack of technical support (3.88); students' misconceptions about physics (3.84) and teachers' insufficient subject knowledge (2.78) were the main obstacles to teaching and learning physics. Inadequate physics teacher numbers (3.72), an overburdened curriculum, and a dearth of teacher mentors (3.68) were other contributing issues. The information showed that the biggest factor affecting physics instruction and learning is a lack of qualified physics teachers.

Table 5. Teacher views on constraining factors to teaching and learning of physics

Statements on constraining factors	N	R	S	A	Mean	Std. dev
Constraining Factors						
Students' perception of physics	0	6.0	4.0	90.0	3.84	0.51
Parental and societal perceptions about the difficulty of physics	0.0	0.0	12.0	88.0	3.88	0.32
Inadequate professional physics teachers	0.0	0.0	2.0	98.0	3.98	0.14
Inadequate teacher subject knowledge	0.0	6.0	10.0	84.0	3.78	0.54
An overloaded curriculum	0.0	12.0	12.0	76.0	3.68	0.69
There are too many mathematical concepts in physics	0.0	2.0	12.0	86.0	3.84	0.42
Inadequate physics teachers	0.0	8.0	12.0	80.0	3.72	0.60
Inadequate laboratory equipment	0.0	0.0	12.0	88.0	3.88	0.32
Lack of technical support	0.0	0.0	12.0	88.0	3.88	0.32
Lack of teacher mentors	0.0	4.0	24.0	72.0	3.68	0.55

Source: Field Survey (February 2022)

4.4. Students constraining factors

The percentage answers, mean scores, and standard deviations of students' answers to items about issues that limit the quality of physics instruction and learning are displayed in Table 6.

The most important factors that students perceived as limiting the quality of instruction and learning were that they found physics to be difficult (3.86), that they were bored with what they did in physics (3.72), that they felt physics was too mathematical (3.70), that they believed they were not very good at mathematics (3.68), that they found physics to be too mathematical (with a mean score of 2.67), that they found it challenging to understand the physics they did (2.53), and that they were curious about what they did in physics (2.50). The other factors perceived by students as limiting the quality of teaching and learning were that students think physics is too hard (2.34).

Table 6. Students' views on constraining factors to teaching physics

Statements on constraining factors	Percentage Responses					
	N	R	S	A	Mean value	Std. dev
I am curious about what we do in physics	0	0	49.0	51.0	2.50	0.50
I am bored with what we do in physics	0.0	8.0	12.0	80.0	3.72	0.60
I don't understand the physics we do	14.0	20.0	66.0	0	2.53	0.71
I find physics challenging	0.0	0.0	14..0	86.0	3.86	0.35
I think physics is too hard/difficult	0	18.0	31.0	51.0	2.34	0.75
I am not good at mathematics	0.0	10.0	12.0	78.0	3.68	0.65
Physics is too mathematical	2.0	37.0	8.0	53.0	2.67	0.63
Physics is too mathematical and scares me	0.0	8.0	14.0	78.0	3.70	0.61

Source: Field Data (February 2022)

4.5. Teachers' views on the ways to improve the teaching and learning of physics

To present the results and findings, information on the instructors' opinions about how to advance physics education was gathered. Better in-service training, Physics teacher cluster meetings for cooperation and experience sharing, the growth of Physics teachers' practical skills, the preparation of Physics graduates for the teaching profession, and an overall improvement in working conditions, including pay and incentives to highlight Physics teachers' accomplishments, are some of these.

Table 7 demonstrates how highly regarded the items were by the instructors on the future directions for enhancing physics teaching and learning, with a mean score of 3.64 and above for each item. Nearly all of the educators thought that to enhance physics instruction and learning, physics teachers should receive higher pay and/or incentives. Better pre-service training (3.72) and physics cluster meetings for idea sharing on teaching physics (3.68) were the other two. The teachers' reaction indicates that they would like to see more professional development for physics instructors, as seen by the item's 3.64 mean score. The data suggest that there is no statistically significant variation in the perspectives of educators regarding potential solutions to the issue of teaching and learning. Physics, since all of the response SD values, on average, are less than 1%.

Table 7. Teachers' views on the way forward to improve teaching and learning of physics

Statement on the way forward	**Percentage responses**					
	N	**R**	**S**	**A**	**Mean values**	**Std. dev.**
Better in-service education	0	6.0	16.0	78.0	3.72	0.57
Physics cluster meetings to collaborate on ideas on physics teaching	0	8.0	16.0	76.0	3.68	0.62
More teacher professional development on physics practical	0	12.0	12.0	76.0	3.64	0.69
More physics graduates are encouraged and/or supported to be trained as teachers	0	6.0	6.0	88.0	3.82	0.52
Better salary and/or incentives for physics teachers	0	0	14.0	86.0	3.86	0.35

Source: Field Survey (February 2022)

4.6. Way forward for students

Data on students' suggestions for bettering physics instruction and learning are shown in this section. It encapsulates ideas such as the need for sufficient laboratory equipment, the need for physics lecturers to actively engage students during class, the necessity of giving physics more time than other courses, and the need for more examples while addressing problems. Details are given in Table 8. The students' (3.67) mean score indicated that physics required more time than other subjects, and lastly, Additionally, students' mean score for believing that physics teachers should involve their students more in class was 3.53, while students' mean score for believing that more practical work is necessary to help them understand physics subjects was 3.48. Once more, the average score for those who said that schools should have laboratory equipment was (3.44). In terms of mean score, students who said that "problem-solving should have more examples" were (3.43). Since all of the replies provided in terms of standard deviation were smaller, the data showed no discernible variation in the opinions of the students regarding the course of action.

Table 8. Students' views on the way forward to improving teaching & learning physics

Statement on the way forward	**Percentage responses**					
	N	**R**	**S**	**A**	**Mean values**	**Std. dev**
Teaching and learning Physics should be practical	0.00	0.00	52.0	41.0	3.48	0.50
Adequate laboratory equipment	00.0	00.0	55.0	45.0	3.44	0.50
Physics teachers should engage students more during lesson hours	00.0	00.0	47.00	53.00	3.53	0.50
Allocating more hours to Physics than to any other course	00.0	00.0	33.0	67.00	3.67	0.47
Problem-solving should have more examples	00.0	00.0	45.0	55.0	3.43	0.51

Source: Field Data (February 2022)

4.7. Discussion

The results (2.66) showed that teacher-centred physics instruction was preferable to student-centred instruction. This was more evident in the opinions of the pupils. It could appear from this that most of the time, students were not given the chance to be at the centre of the physics class interactions. The findings made it evident that pupils had to adhere to instructional strategies, which they found objectionable. Concurrently, studies have shown that transmitting knowledge of scientific concepts to students through teaching and learning that is not student-centred is unproductive (Sunal *et al.*, 2015). The students' responses, which revealed that teachers present lessons on problem-solving on the Whiteboard without the students' participation, also serve as evidence of the traditional teaching methodology. Again, this is an indication that most senior high schools in this study show that teachers still use the traditional system of lesson delivery. This is in line with the findings of Sunal *et al.* (2015), who identified that physics interaction classes were dominated by a teacher-centred approach and Whiteboard instruction.

The findings showed that teachers believe that the main barriers to physics teaching and learning in senior high schools are a lack of qualified physics teachers, inadequate laboratory equipment, students' perceptions of physics, and inadequate teachers teaching physics. The findings also showed that insufficient laboratory equipment hinders senior high school physics instruction and learning. This may be the cause of the majority of scientific instructors' typical whiteboard presentations of concepts. Students' ability to learn physics in senior high school is hampered by teachers who employ the traditional teaching approach, particularly at institutions with less sophisticated equipment. The findings also suggested that one factor impeding physics teaching and learning is a lack of qualified professional physics professors. This restriction is more likely to be observed at senior high schools in remote areas, as the majority of these institutions lack enough science teachers to adequately instruct the student body. Teachers have identified students' perceptions of physics as another barrier to physics teaching and learning. Students believe that physics is a tough subject to learn. Teachers also mentioned a shortage of teacher mentors and an overburdened curriculum as barriers. The results of the teachers' comments showed some of the ways that physics teachers would like to see improvements made to physics education. The government should raise physics instructors' pay and/or provide them with more incentives, according to physics teachers, as one approach to improve physics education. The physics teachers appear to find this to be the most significant.

Every organisation needs professional development to succeed. Ensuring that science instructors routinely undergo professional training to improve their teaching skills is the responsibility of the government and relevant agencies. Educating more graduates in physics to become teachers is another crucial method that educators may work to enhance physics education. The findings also indicated that more pre-service training and physics cluster meetings to exchange ideas on physics instruction were further strategies to enhance physics teaching and learning. The students recommended that the relevant authorities supply the schools with sufficient laboratory equipment to enhance the practical component of physics instruction.

5. CONCLUSIONS

The primary methods of teaching physics in senior high schools are, first, the use of demonstration and discussion of the results to illustrate concepts and phenomena, an emphasis on qualitative thinking and concept presentation, a focus on the mathematical presentation of concepts, students organizing and conducting their experiments, teacher demonstration of problem-solving on the whiteboard, and teacher-centred teaching and learning. Regarding the difficulties in teaching and studying physics in senior high schools, students' study findings showed that professors of physics in these institutions tend to employ more conventional methods. Additionally, the research reveals that the primary barriers to physics instruction in senior high schools were a lack of qualified physics teachers, inadequate laboratory supplies, a shortage of physics instructors, and students' opinions that physics was too subjective and mathematical to study. Because there are not enough qualified physics teachers in the field, the relevant authorities must take action to guarantee that physics teachers continue their education beyond school. The issue is that physics teachers typically find it challenging to gain all the knowledge necessary to do a good job of teaching because of the short amount of time they spend in school.

RECOMMENDATIONS

The creation of a regional collaborative professional development framework tailored to Greater Accra's physics instructors is highly recommended by this study. This approach should establish subject-based learning communities across schools and match more seasoned physics instructors with less experienced ones in formal mentorship programs. Schools in under-resourced areas would especially benefit from such collaboration, which would alleviate the significant shortage of competent physics teachers found in the research. Regular hands-on workshops centred on laboratory demonstrations, contextualising abstract ideas, and incorporating locally accessible instructional tools should be part of the framework. Despite budget limitations, this intervention has the potential to be transformative because, as Buabeng *et al.* (2018) highlight, teacher quality is the most important controllable element determining student physics achievement.

Given the serious lack of lab space and educational resources found in this study, we advise Greater Accra schools to create a formalised network for exchanging physics resources. This network would include digital resource repositories, equipment rotation programs, and coordinated scheduling systems for shared laboratory access, as well as the deliberate clustering of schools according to proximity and resource complementarity. Students from partner institutions could alternatively attend practical courses at schools equipped with specialised equipment. This strategy promotes long-term infrastructure development while providing a workable short-term fix to short-term resource shortages. With only 17% of the region's schools having properly furnished labs, this cooperative model has the potential to greatly increase possibilities for hands-on learning without necessitating an immediate, substantial capital expenditure.

Better conditions of service, such as increased pay and/or incentives for physics teachers, equipped science laboratories to improve teaching and learning, professional career development of physics teachers on physics practicals, and combined training of more graduate teachers, were identified by teachers as ways to improve physics teaching and learning. Consequently, it is the responsibility of the government and the relevant education-related agencies to supply the lab equipment required to support physics instruction. The appropriate authorities need to take action against this issue because if they don't, kids' performance in science classes will suffer. This shows that to help students grasp physics, physics professors need to embrace new and innovative teaching strategies, including modelling, animation, and simulation. To foster student interest and enjoyment in physics instruction, it is imperative to tackle the aforementioned obstacles.

LIMITATIONS OF THE STUDY

The use of descriptive statistics in this study restricts the capacity to establish causal links between identified factors and learning outcomes, even though they are suitable for mapping the educational landscape. Due to the cross-sectional nature of the data collection, seasonal fluctuations in educational practices or resource availability may be missed, as it only offers a picture of present conditions rather than documenting patterns over time. Furthermore, social desirability bias may be introduced by the self-reported nature of some data, especially when it comes to teaching methods, as teachers may report idealised rather than real classroom behaviours.

Though concentrating on the Greater Accra Region in particular offers insightful contextual information, it restricts generalisability to other Ghanaian regions with distinct socioeconomic characteristics, cultural settings, and educational opportunities. The under-representation of urban-rural discrepancies within Greater Accra itself could result from sampling that favours more accessible schools. The study's sole emphasis on senior high schools also precludes an analysis of how pupils' attitudes and readiness for physics are influenced by their previous basic school experiences. Additionally, while the study records official in-school factors, it does not effectively address crucial out-of-school influences that have a substantial impact, such as family educational history, availability to supplemental learning resources, and community attitudes towards science education.

To evaluate the impact of identified determinants on long-term educational and professional trajectories, future research should employ longitudinal studies that follow physics students from Form 1 through university. This research would look at how early exposure to physics affects career development, perseverance in STEM disciplines, and subsequent academic choices. Researchers could determine crucial intervention windows and assess the long-term effects of educational reforms by gathering data at various intervals. In addition to addressing the temporal restrictions of the current study, this strategy would offer insightful information about how early physics education influences the development of Ghana's scientific workforce.

Building on the descriptive results of this study, researchers ought to create and assess focused treatments that target certain obstacles found in physics education. Evidence of which interventions result in quantifiable gains in physics teaching and learning outcomes could be obtained by experimental or quasi-experimental research comparing creative teaching methods, resource allocation plans, or mentorship initiatives. To find lasting solutions appropriate for Ghana's educational context, such research should incorporate cost-effectiveness assessments, with a special emphasis on treatments that could be successful despite resource limitations. Studies could assess the effects of peer teaching models, physics clubs, or mobile laboratory programs on student performance and attitudes, for instance.

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