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The Status of Resource Availability and Science Teaching at the Junior High School Level in Ghana

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Abstract

The study focused on the status of teaching and learning of science at the Junior High School (JHS) level within the Ghana Education Service (GES). It looked at key features of quality education delivery such as teaching strategies and availability of resources for teaching science at the JHS level. The research design was a cross sectional survey involving 9 public schools in the northern region of Ghana. The sample size was 45, consisting of 9 science teachers, and 36 students. Tools used for data gathering included a questionnaire, an interview guide and an observation checklist. Through the study, it came to light that issues such as inadequacy and unavailability of resources as well as the use of teacher-centred approaches militated against the smooth learning of science by students. Recommendations made include the training of teachers on improvisation as well as the conduct of regular professional development sessions for teachers.

Keywords: Improvisation, Learner-Centred Pedagogy, Activity-Based Learning, Social Constructivism

1. Introduction

Science is one of the core subjects accounting for the promotion of students from Junior High School Level (JHS) to the Senior High School Level (SHS). At the JHS level, Integrated Science is one of the subjects that learners find difficult to understand (Adu-Gyamfi, 2014).

The WAEC Chief Examiners report of 2016 cited the poor performance of candidates in the BECE Integrated Science Paper. As pointed out by Anamuah-Mensah et al. (2017), a myriad of factors account for students' poor performance in science. At the Junior High School level, several factors have been identified to be contributing to the poor performance of students in science (Adu-Gyamfi, 2014). These include the instructional approach of teachers, curriculum overload and home background of learners (Igbo & Omeje, 2014). Other contributory factors to students' poor performance in science are poor quality of teachers, unavailability and inadequacy of teaching and learning resources as well as ineffective school leadership and lack of efficient supervision (Dass & Yager, 2009).

Teacher competence is a principal factor in the academic achievement of students in all subjects including science (Yeboah, 2016; Marzano et al., 2000). Thus there is an imperative need to make adequate provisions to enable teachers effectively carry-out their mandate.

Azure (2015) has stressed on the integral role of teachers in the successful academic achievement of students. NaCCA (2020) stressed that in the study of a practical-oriented subject like science, skilled and competent practitioners are critical to the learning process.

The northern region is one of the sixteen (16) administrative regions of the country. The trend in BECE results from the region in recent years shows that generally students underperform in the integrated science paper (WAEC, 2020). Considering the importance of integrated science as a subject that lays the foundation for further learning of science at the SHS level, this unfortunate trend calls for immediate intervention. In the present study, the intended outcome was to identify the status quo with regard to the delivery of science education at the JHS level within the northern region of the Ghana Education Service.

Data from the 2021 population census cites the northern region as having a greater number of inhabitants based in the rural areas. In a typical rural community in Ghana, issues such as poor supervision, ineffective leadership, unavailability and inadequacy of teaching and learning resources characterize the teaching and learning process (Donkoh, 2016). Goodpaster et al. (2012) revealed that urban-based teachers exhibited better professional ethics than rural-based teachers. Similarly, Shadreck (2012) observes that generally urban-based schools were more likely to be better stocked in terms of relevant learning resources than rural schools. In the light of policies and interventions to boost universal access to quality education as enshrined in policy documents such as the Education Strategic Plan (ESP) of 2018 – 2030, the National Pre-tertiary Education Curriculum Framework (NPECF) and the National Teacher Education Curriculum Framework (NTECF), there is the need to identify and address the bottlenecks to the attainment of quality pre-tertiary education. Considering the importance of science as a subject that lays the foundation for further learning of science at the SHS level, this issue calls for immediate attention. For this reason, the study sought to identify the status quo in terms of teaching approached used by science teachers as well as the level of science resource availability and adequacy at the JHS level within the country. The overarching aim is to come-out with findings and appropriate recommendations for improving learning outcomes in science at the JHS level.

2. Literature Review

2.1. *The role of Teaching and Learning Resources in Science*

Instructional resources are the pillars based on which learner-centred teaching of science is driven. That is to say, no meaningful learning of science can take place devoid of the use of appropriate resources.

As observed by Yildirim (2021), these resources promote easy learning understanding of concepts and acquisition of skills. Many studies including that of Igbo and Omeje (2014) give evidence that the use of resources leads to improved academic performance of students.

The issue of absence or inadequacy of TLRs is a mainstay of education in Ghana particularly at the pre-tertiary level (Okhiku, 2005). This problem is more prominent at rural-based schools compared to urban schools (Tety, 2016; Yeboah et al., 2019). Adeogun (2001) found out that public schools in particular lacked access to basic resources such as measurement equipment, laboratory apparatus and chemical reagents critical for effective lesson delivery. Okobia (2011) stressed that the inadequacy of appropriate resources makes science learning difficult. Several factors account for the failure of teachers to use resources in lesson delivery. These include (1) unavailability or inadequacy of resources, (2) lack of funds, (3) poor maintenance of existing resources (4) absence of storage facilities (5) lack of expertise by teachers, (6) misconceptions on the usage of resources. This has ultimately led to the situation whereby teachers resort to the lecture method of teaching, which is not appropriate for a practical-oriented subject such as science (Makokha & Wanyonyi, 2015). This inhibits the acquisition of science process skills such as observing, manipulating, analyzing, experimenting, measuring and evaluating. The increasing role of ICT in education delivery was expected to serve as a supplement or in some cases substitute for the absence of realia so far as practical science learning was concerned (Magawata et al., 2011). This is made possible through access to videos, pictures, virtual laboratories and other e-resources on various science concepts. Unlike urban-based schools, rural schools are unable to gain access to these resources due to a number of reasons

including absence of electricity in the school, absence of ICT logistics and storage facilities, lack of technical know-how by teachers (Abba Iya, 2008).

In the absence of resources and ICT equipment, science teachers are expected to resort to improvised learning resources to enable them conduct effective activity-based lessons. However various researchers bemoan the low improvisation skills of science teachers (Be-Bassey, 2012). The culmination of these factors results in the failure of students to understand key science concepts as well as the inability to acquire essential scientific skills needed for successful study of the subject and further progress in the subject at higher levels of education.

2.2. Teaching and learning of science at the basic level in Ghana

The standards-based curriculum which was implemented in Ghanaian basic schools in the 2019/2020 academic year stipulates that teachers are expected to conduct lessons in a learner-centred manner, guide and assist learners to create their own knowledge (NaCCA, 2019). This can be attained in an atmosphere where teachers adopt approaches and strategies that create opportunities for students to interact with each other and with relevant resources throughout the learning process. In the words of Dass and Yager (2009), the role of the teacher is to provide an enabling learning atmosphere that makes use of relevant strategies to ensure active student participation in the learning process. The CCP science curriculum stresses on learner-centred teaching. It also talks about a key aim of science learning as developing a new generation of students who are scientifically literate and who apply scientific principles to solve everyday problems (NaCCA, 2020).

Learner-centered methods that promote deep understanding and the acquisition of skills and competences include activity-based methods, group work, role-play, simulations and demonstrations (Muzumara, 2011). Previous studies (Picciano, 2009; Namrata, Amrita, & Singh, 2014) prove the efficacy of these methods in promoting conceptual understanding and improved attitudes of students towards the study of science. Anney and Hume (2014) found out that many science teachers fail to use such participatory teaching strategies. Similarly, Kuyini and Abosi (2014) noted that the lecture method is the prominent pedagogical approach of most science teachers. Though the lecture method has the advantage of being time efficient and requiring less resources for lesson preparation, it is deemed unsuitable for science teaching based on a number of reasons. Firstly, it does not ensure active participation of learners. It also inhibits the acquisition of skills and competencies (Ohle et al., 2015). As noted by Poggi et al., (2017) students taught using the lecture method are more likely to develop misconceptions about various science concepts. There are several reasons responsible for teachers' failure to use learner-centred approaches in delivering lessons (Gurganious, 2017). These include large class sizes, unavailability of resources, lack of motivation and lack of regular in-service training. Previous studies (e.g., Borko et al, 2010; Van Es, 2012) reveal that when teachers are taken through regular professional development sessions, it results in better teaching and a corresponding enhancement in students' achievements. It is necessary for stakeholders to factor these challenges into teacher education curriculum and the content of professional development programmes so that all bottlenecks that hinder teachers from employing learner-centered approaches in science teaching are effectively addressed.

3. Objectives

The study sought to attain the following objectives:

1. Identify the teaching and learning strategies used by JHS science teachers within the Northern region.
2. Determine the kind of resources available for teaching science at JHSs within the Northern region.
3. Find out the suggestions from stakeholders (teachers and students) towards improving science teaching and learning at the Junior High School level.

4. Research Questions

1. What are the teaching and learning strategies used by Junior High School science teachers within the Northern region?

2. What are the resources available for teaching science at the Junior High School level?
3. What are the suggestions from stakeholders (teachers and students) towards improving science teaching and learning at the junior high school level?

5. Methodology

The study employed the mixed methods approach. Dillman et al (2014) suggest the use of the mixed method when one method may not be adequate and also to reduce the potential of measurement error. The research design used in the present study was a survey. A survey makes it possible to make generalizations about a larger population from a smaller one (Singleton & Straits, 2009). As Ponto (2015) points out a survey allows the researcher to use a plethora of strategies to recruit research subjects and gather data through the utilization of different instruments. In this study, the survey was used to enable the researcher gather sufficient data about the trend in teaching and learning in the 16 schools within the northern region by carefully selecting respondents based on different biographic settings. Stratified random sampling was used to select nine schools within the region consisting of 3 each from rural, semi-urban and urban schools within the region.

Out of this, nine schools were involved in the study. From each school a total of 5 respondents were selected, consisting of one science teacher, two male students and two female students. Thus, a total of 45 respondents were involved in the study. Consisting of 9 science teachers and 36 students.

The schools in the region were grouped into urban, peri-urban and rural schools based on their demography. Three each of the schools under each category were randomly selected. The science teachers in each of the nine selected schools were selected to be part of the study. In instances where there were 2 science teachers, one was randomly selected. The students in each school were placed into two groups, males and females. Two males and two females were randomly selected from each group. These approaches were adopted to ensure fair representation of schools, teachers and students from different backgrounds in terms of gender and demography.

A questionnaire and interview guide were used to gather data from science teachers and students within the selected schools. Frankel and Wallen (2000) stressed the purpose of a questionnaire as helping to find out what is on people's minds, what they think or how they feel about something. Both the questionnaire and Interview Guide were used to gather data from the science teachers. Dillman et al. (2014) suggest the use of the mixed method when one method may not be adequate and also to reduce the potential for measurement error.

An interview guide was used to gather data from the students. An interview guide is helpful because, the interviewer can use probing comments to obtain more information about a question or topic and can request clarification on an unclear response (Singleton & Strait, 2009). A checklist was used to determine the level of resource availability in each school.

The data gathered using the questionnaires was analysed using the SPSS software. The information gathered with the interview guide was also analysed using a thematic approach. This enabled the researcher to identify recurring themes from the responses provided by the study subjects. The data gathered with the observation checklist was also analysed thematically to augment data gathered with the aid of the questionnaire and interview guide. The frequencies and percentages of the data gathered with the questionnaires were computed to aid in easy interpretation and understanding.

6. Results and Discussion

6.1. Demographic Data

Table 2: Distribution of Schools based on location

Urban Circuit	Peri urban	Rural
Kpandai D/A JHS	Buya Destiny JHS	Kumdi D/A JHS
Kpandai Girls Model JHS	Katiejeli EP JHS	Bankamba JHS
Balai D/A JHS	Buya D/A JHS	Kojoboni JHS

The urban-based schools involved in the study were Kpandai D/A JHS, Kpandai Girls Model School and Balai D/A JHS. The peri-urban schools were Buya Destiny, Katiejeli EP JHS and Buya D/A JHS. Kumdi D/A JHS, Bankamba JHS and Kojoboni JHS were the three rural-based schools that took part in the present study.

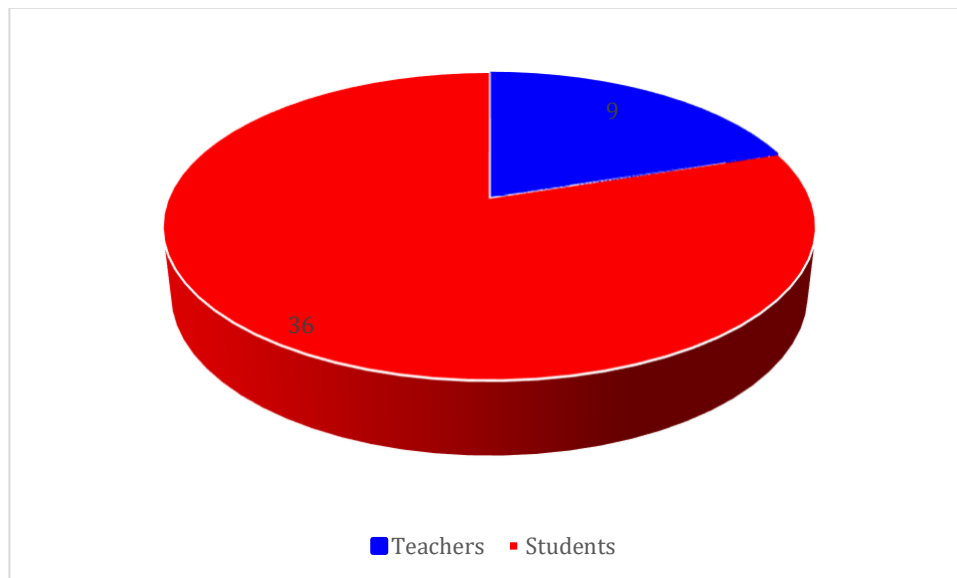


Figure 1: Distribution of Respondents involved in the Study

6.2. The Teaching and Learning Strategies used by Science Teachers

6.2.1 Analysis of Teachers Responses

Data gathered with the aid of the questionnaire for teachers revealed that, the JHS science teachers within the Northern Region used a plethora of teaching and learning strategies for science teaching. Six out of the 9 respondents representing 66.7% of the teachers involved in the study indicated that they used the discussion method for lesson delivery.

A further 7 of the respondent teachers revealed using various group work strategies during science lesson delivery. Notably, only two teachers cited the usage of project-based learning as a key method of science teaching. Five out of the 9 respondents indicated that they used the demonstration method during science lessons.

Table 3: Teaching Strategies used by Science Teachers

Teaching Approach	Frequency	Percentage
Discussion	6	66.7%
Demonstration Method	5	55.6%
Group Work	7	77.8%
Project Based Learning	2	22.2%

The data provided in Table 3 reveals that teachers seldom used the activity-based method of science teaching and learning. It can also be seen that none of the respondents used learner-centered methods such as role play and simulation during science lessons.

Strategies such as nature's walks, field trips, and use of educational videos were not cited by any of the respondent teachers.

6.2.2. Availability and Use of TLMs in Lessons

Table 4 gives a breakdown of teachers' responses to the resources available in their schools for the teaching and learning of science. The data provided in Table 4 shows that most of the 9 schools had no models, nor charts.

Table 4: Resources available for teaching science at the various schools

Resources	Frequency	Percentage
Models	2	22.2
Charts	5	55.6
Reagents	3	33.3
Measuring instruments	2	22.2
Others	4	44.4

Three out of the 9 schools had sample reagents for teaching some science concepts. Essential equipment such as measuring instruments, electrical gadgets and equipment, were unavailable in all of the 9 schools. Notably ICT resources such as Laptops and projectors were unavailable in most schools.

Many teachers cited the absence of these requisite resources as the main reason accounting for the poor performance of pupils in science.

They generally advocated for the provision of TLMs as the main panacea to the problem of ineffective science teaching and learning at the Northern region directorate of education.

6.2.3. Feedback from Observation of Lessons

Teaching strategies applied during science lessons

During the observation of lessons, it came to light that the lecture method was the most predominant method of lesson delivery, followed by the question and answer mode of teaching. There was little or no use of science equipment during lesson delivery. Learners were generally motivated through clapping by colleagues and praises from the teacher.

Interaction among learners

Majority of teachers did not create the opportunity for sufficient interaction amongst learners. Only two teachers out of the 9 observed engaged learners in group activities.

Usage of Teaching and Learning Resources during lessons

Out of the total of 10 lessons observed, only 4 teachers employed the use of Teaching and Learning Resources. The predominant resources used were charts.

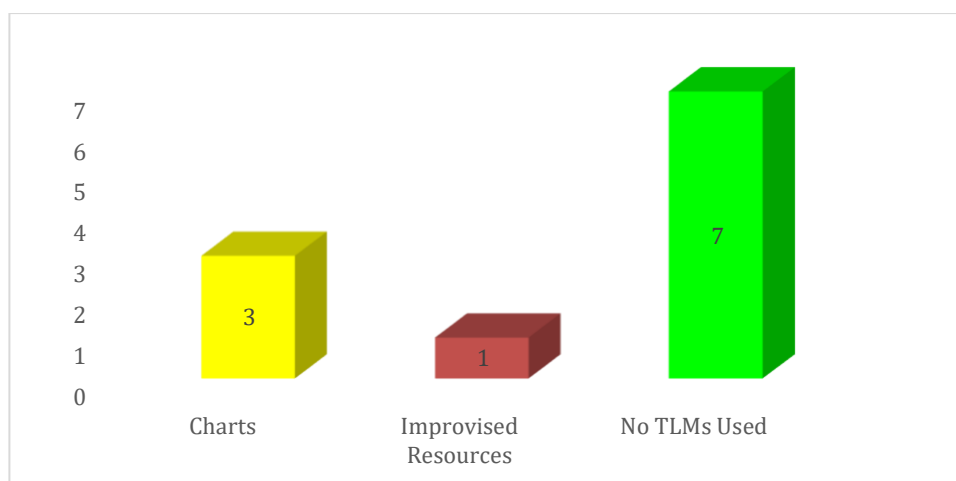


Figure 2: Breakdown of lessons observed and TLMS used

During a lesson on separation of mixtures, one teacher used an improvised thermometer to demonstrate the separation of a mixture of a liquid and an insoluble solid through the method of filtration. As evident in figure 2, no TLMS were used in 7 out of the 10 lessons observed.

6.2.4. Other Key Findings from Observation of Classroom Lessons

Lesson plan Development

Generally, lesson plans were well written, with provisions for assessment, active learner participation and use of TLMS well spelt-out.

Content delivery

Most teachers failed to follow the guidelines they had set out in their own lesson plans. The use of TLMS was minimal, whilst lessons were mostly teacher-centred. In half of the lessons observed, teachers showed limited understanding of the content being taught in class during the lesson presentations.

Classroom organization and management

Based on the problem of overcrowding, teachers did not rearrange the class during any of the lessons observed. However, teachers were able to manage disruptions and gain the attention of pupils throughout the lessons.

Improving instructional activities

Though provisions for reflective actions were spelt-out in the lesson plans, they were not adhered to in most of the lessons observed.

6.3. Summary of Learners' Views about their Science Teachers

6.3.1. Approaches used by teachers for teaching Science

Through the interactions with the focus groups, it came to light that the main approach used by science teachers was the lecture method. Another key technique used by science teachers was the question-and-answer technique. It was revealed that occasionally group-based strategies were used by science teachers. Approaches such as activity-based learning, demonstrations, use of videos and other ICT-based approaches were seldom used in science lesson delivery.

6.3.2. Students' views about the teaching strategies of science teachers

Most students were not pleased with the way and manner in which their science teachers taught the subject. According to the participants in the focus group, the teaching strategies used rendered it difficult for them to

understand the science concepts being studied. For this reason, many students were not interested in the study of science.

6.4. Improving the Teaching and Learning of Science at JHS

6.4.1. Teachers' views on how to Improve Science Teaching and Learning

During the interview sessions with the 9 respondent teachers, some recommendations were made to improve the teaching of science at the JHS level. Their suggestions are summarized in Table 6.

Table 6: Teachers' Views on how to Improve Science Teaching and Learning

Suggestion	Frequency
Provision of equipment	(9)
In-service training on learner-centred teaching and improvisation techniques in science	9
Setting up of ICT laboratories in schools	3
Building of science centres	1
Reduction in content of the science curriculum for JHS	1

It is evident from Table 6 that all the nine respondents suggested the provision of relevant equipment such as reagents, models, charts and apparatus to ensure effective science teaching. Additionally, all respondents felt the need to conduct in-service training sessions in order to update and equip JHS science teachers with the relevant skills in improvisation and learner-centred approaches to science learning.

6.4.2. Suggestions to Improve Learning

During the interview sessions, teachers made the following suggestions for consideration by stakeholders in a bid to improve the learning of science by JHS students:

- Provision of equipment to enable hands-on learning and activity-based learning
- More teachers should be recruited to teach science in the schools.
- GES must make a pass in integrated science a requirement for SHS placement
- Teachers must use different approaches (nature walks, visitations to STEM centres) to teach science in order to make the subject interesting to the learners.
- Provision of science textbooks to all students

6.4.3. Students' Suggestions for improving science teaching and learning

These were some of the approaches suggested by the focus groups for improving science lesson delivery by their teachers.

- Teachers should engage them (students) in practical activities
- Experiments must be conducted during science lessons
- They (students) would like teachers to involve them more during lessons
- Teachers must use science resources and equipment during science lessons

6.5. Discussion of Results

6.5.1. Teaching and Learning Methods used by teachers

The NPTECF (2019) stresses that learning within the Ghanaian school context hinges on social constructivism where the learner is prioritized in the daily teaching and learning process. In this vein, the teacher plays the role

of a facilitator who provides the environment necessary for students to construct their own knowledge (Borich, 2007; Boakye & Ampiah, 2017). Although teachers indicated that they used various learner-centred strategies, observation of lessons indicated otherwise. Science lessons were mostly conducted in the teacher-centered manner, a phenomenon which is similar to the findings of Bizimana and Orodho (2014) and Osei-Himah and Adu-Gyamfi (2022). Considering the practical nature of science, the failure of teachers to employ learner-centred approaches poses the risk of promoting misconceptions, poor attitude and general lack of interest in the subject by students. Additionally, students will not be able to acquire the key scientific process skills such as observing, analyzing, manipulating, evaluating and experimenting which are critical to their academic attainment in the subject (Haffar, 2016). The standards-based curriculum for science emphasizes on differentiation to suit the learning needs of different categories of learners. Teachers over reliance on the lecture method renders it difficult to address the learning challenges of learners with various learning challenges (Heather, 2020).

6.5.2. Status of Resource Availability and Adequacy

Bukoye (2019) outlines the role of instructional resources as the driving force behind any effective classroom learning. The use of resources makes science relevant and meaningful to students whilst also improving their attitude and conceptual understanding (Opara & Etukudo, 2014). Various studies reveal that generally schools in Ghana lack relevant resources for undertaking effective teaching and learning of science (Heather, 2020; Ampofo, 2020). For this reason, various researchers recommend that teachers resort to improvised equipment and resources for undertaking effective science teaching. In the current study, most schools lacked science laboratories or the requisite science equipment. This was exacerbated by the fact teachers lacked improvisational skills. Ampofo (2020) stressed on the abstract manner in which science is taught due to the absence of resources. The absence of improvised teaching and learning resources suggests that teachers lack the essential skills of improvising, which is similar to the findings by Davis & Chaiklin, (2015). The absence of regular in-service training and professional development sessions, is a possible cause of teachers' poor improvisation practices and skills. Stakeholders such as the head teachers, district and regional educational staff can also be faulted for the absence of the required science teaching and learning resources. The absence of textbooks for students is noteworthy, and should be a matter of concern to all stakeholders.

7. Conclusion

The study has been very insightful in bringing to fore some key factors affecting the learning of science at the JHS level within the country. The study provides a holistic view of the situation by gathering data from both classroom practitioners as well as learners. All categories of respondents acknowledged that the absence of relevant learning resources has a significant impact on the effective teaching and learning of the subject. The observation that most teachers use the lecture method in lesson delivery is worrying, since this approach of teaching does not promote the acquisition of relevant practical skills, which is the bedrock of science learning. It also inhibits the effective understanding of concepts by learners. Most definitely, it will result in learners developing a negative attitude towards the subject and discourage them from further pursuing science at the higher level. With regular in-service training coupled with the supply of relevant logistics, JHS science teachers will be well-positioned to effectively teach science leading to better learning outcomes.

8. Recommendations

- There must be regular in-service training on improvisation techniques in science teaching for all science teachers at the Junior High School level of the Ghana Education Service (GES).
- The GES and other concerned agencies and stakeholders must organize training sessions for science teachers on learner-centered approaches to teaching. This must focus on the effective application of various teaching techniques such as the activity method, discussions, role play, think pair share, group work in lesson delivery.
- In this era of modernization, the capacity of teachers must be enhanced in order to enable them make full use of ICT and internet resources in lesson planning, teaching and assessment of learners.
- Training of teachers on how to effectively teach **perceived difficult topics** conveniently.

- Through the help of the regional STMIE coordinators, a network of science coordinators and teachers must be formed to enable science teachers share ideas and experiences towards improvement in their classroom delivery.
- Science is a practical and activity-based subject. For this reason, resources such as charts, models, reagents, basic laboratory equipment must be supplied to all the Junior High schools in the northern region to help ensure effective science teaching and Learning.
- Students must be supplied with relevant science textbooks to help them undertake independent and further study of the subject after school. This will help to boost their conceptual understanding of key science concepts.

9. Limitations

Some of the teachers had worked for a relatively short time, which implies they might not be very familiar with all the resources available within the school for teaching science. Some respondent science teachers also did not have a science background, and this might have had an influence on the responses they provided, such as the suggestions and recommendations for improving science learning at the JHS level.

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