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ANALYSIS OF THE FACTORS AFFECTING LOW PERFORMANCE OF SENIOR HIGH SCHOOL STUDENTS IN INTEGRATED SCIENCE

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Abstract:
The purpose of the study was to investigate the factors that affect the low performance of senior high school students in Integrated Science in the Tamale Metropolis. Concurrent triangulation mixed methods design was used. The instruments used during data collection were questionnaires and interview guide. A multistage sampling process was used to select four hundred students and fifteen teachers who teach Integrated Science. Data collected was analysed using exploratory factor analysis and thematic content analysis. The study revealed three factors: school environmental factor, teacher attitude and student attitude as contributors to students' low performance in Integrated Science. It is, therefore recommend that the education ministry should provide a comfortable learning environment for effective teaching and learning to improve students' performance in Integrated Science.

Keywords: education, integrated science, environmental factor, teacher attitude, student attitude

1. Introduction

According to the West African Examination Council (WAEC) chief examiners' report 2016, one weakness noticed in Integrated Science Paper 2 was the sign of poor preparation and readiness for the examination (WAEC, 2016). In the WAEC chief examiners' report 2017, it has also been recorded that students performed poorly in Integrated Science in the West African Senior School Certificate Examination (WASSCE) that year (WAEC, 2017). Poor performance in Integrated Science did not start now but it dates to 2006 (Education, 2015). The pass rates of senior high students (SHSs) from 2006 to 2018 in WASSCE are presented in Figure 1.

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Figure 1 shows WASSCE pass rates in core subjects from 2006-2018 excluding 2010 in which WASSCE was not conducted. Social Studies recorded the highest pass rates from the year 2006 to 2018 followed by English language. Integrated Science for WASSCE pass rate though it rises and then falls, it has never exceeded 52% from 2006 to 2018 therefore the results are not very good. In the year 2012, students performed very well having almost a 50% pass rate but the performance of students in Integrated Science dropped drastically in 2013. From 2013 to 2015, students' performance remained as low as 34.33% averagely. Then in 2006, students performed well in Integrated Science. In the WAEC Chief examiner's report for Integrated Science in 2006, students' performance in Integrated Science was described as an improvement compared to the previous year (WAEC, 2007). However, in 2017, the chief examiner for Integrated Science WASSCE stated vividly that performance that year was poor; Figure 1 agrees with the chief examiner's report. Figure 1 also shows that there was a rise in 2018 WASSCE student performance from 43% pass rate in 2017 to 51% pass rate in 2018 (WAEC, 2018).

A total of 289,168 students registered for the WASSCE 2017 in Ghana, and this is 5.45% higher than the 2016 students of 274,209 and the examination was organized for 916 senior high schools (WAEC, 2017). The WASSCE grading system uses A1 to represent a score of 100-80 which means excellent, B2 is a score of 79-70 which means very good, B3 is a score of 69-65 interpreted as good, C4, C5 and C6 is a score of 64-60, 59-55, 54-50 respectively which is interpreted as credit. Also, D7 and E8 represent a score of 49-45 and 44-40 respectively and are interpreted as pass. Finally, a score of 39 and below is graded as F and interpreted as fail. In Ghana, the statistics for Integrated Science as one of the four core subjects in 2017 revealed that 125,204 (42.52%) obtained A1-C6, 84,851 (30.73%) obtained D7-E8 whilst 76,693 (26.75%) obtained F9 (WAEC, 2017). This shows the rate students passed in WASSCE 2017 for Integrated Science in all Regions in Ghana was 42.52%. The pass rate for all regions in Integrated Science WASSCE 2018 was 50.5%. Although 2018 performance is high compared to 2017, the pass rate statistics in Integrated Science show a consistent higher pass rate to raise the scientific literacy of every Ghanaian to improve the nation's economy. If according to WASSCE grading system, a score from 100 to 80 is termed as excellent then the pass rate of Integrated Science in Ghana should strive to be excellent.

Generally, the performance statistics in Integrated Science in Ghana are not very good based on Figure 1. Also, Ghana Education Service (GES) released a statistic on educational sector performance in the then Northern Region and the performance in Integrated Science is depressing to say the least. Also, over the past 5 years the then Northern Region scored below average results in their schools (Joseph, 2015). According to WAEC, in 2015 like 2014, out of the four core subjects, the pass rates of Integrated Science greatly diverged from that of Social Studies and English. A proportion of 23.6% of students passed in Integrated Science which is not encouraging. From 2006 to 2015 comparing the WASSCE pass rates in core subjects by regions, Northern Region performed poorly sometimes significantly lower than other regions (Education, 2015).

One difference in scores across regions recorded for Integrated Science was where 31.8% more candidates passed in Ashanti Region as compared to the Northern Region in 2015.

Table 1 shows the WASSCE pass rate of Integrated Science among the 10 regions of Ghana from 2013 to 2017. A careful look at Table 1 reveals that across the regions, average performance of Integrated Science in 2014 and 2015 was lower compared to 2013, 2016 and 2017. Mainly for all five years, Northern Region has continuously performed the least compared to the other regions in Ghana. Therefore, issues concerning factors affecting students' academic performance remain a high concern for administrators, stakeholders, parents, and students themselves (Baidoo-Anu, 2017). Performance in Integrated Science is relatively low compared to other core subjects in Ghana but more significantly lower pass rate for integrated science is recorded in the Northern Region of Ghana. There was therefore a need to conduct research to identify factors that support the low performance of SHS students in Integrated Science in the Northern Region.

1.1 Research Question

- What are the underlying factors that influence students' low performance in Integrated Science in Tamale Metropolis?

2. Methodology

2.1 Research Design

The research design is about the total process utilised by the researcher to discover answers to research questions and to explore fiction (Dadzie, 2013). Mixed method particularly, convergent parallel mixed method was used in this study. A convergent parallel mixed method is where both quantitative and qualitative data are collected at the same time and compared to understand the research problem (Creswell, 2012). In the case of this study, both quantitative and qualitative involves asking questions arranged as a written questionnaire to many individuals (Fraenkel, Wallen, & Hyun, 2012; L. Mitchell & M. Jolley, 2010). At the quantitative stage, descriptive survey contributes to students' low performance in Integrated Science.

Also, the design in a form of questionnaire was used to acquire information about the factors in the schools. Qualitative data in the Interview guide was prepared for teachers in the selected SHSs. This was to determine the factors that influence students' low performance in the Tamale metropolis and interpreted to relate to the quantitative data. Mixed methods approach has been used because it provides strengths that eliminate the weaknesses in quantitative and qualitative research. Both quantitative data and qualitative data were analysed and discussed simultaneously to provide the factors that contribute to students' low performance in Integrated Science.

2.2 Population

The population in this study was teachers and students at the SHSs in the Northern Region. The target population was Integrated Science teachers and students in the public

senior high schools in Tamale Metropolis. The accessible population was Integrated Science teachers and students in SHS 2 at selected public second cycle schools in the Tamale metropolis. This is because SHS 2 students have one-year experience in Integrated Science and SHS 2 teachers teach these students. Their views can be linked, therefore, may be in an appropriate position to contribute to the study.

Integrated Science is one of the subjects studied in all the public second cycle schools in the Metropolis whether vocational, technical, or business based schools because it is a core subject. There were fourteen public second cycle schools in the Tamale Metropolis. The average number of SHS 2 Integrated Science teachers and students in all schools in the Tamale metropolis was fifty-six and thirteen thousand, one hundred and fifty respectively. From this number, fifteen teachers and four hundred students were selected for this study. Also, three hundred and sixty-one of the students selected were affiliated to the Islam religion making 90.3% while the remaining was affiliated to the Christian religion. According to the data collected, the occupation of fathers of 68% of the students were self-employed which means that they had their own jobs and fathers' highest educational qualification of 68% students was first degree. Also, occupation of mothers 68% of students was trading and the highest educational qualification of the mothers of 96% students was JHS level.

2.3 Sampling Procedure

A multistage sampling process was used for this study. Schools were stratified into public and private schools. Purposive sampling technique was used to select public senior high schools. This is because there are more public senior high schools than private senior high schools in the metropolis and the option was best to get the desired number of respondents. Five schools out of the fourteen public schools in the Tamale metropolis were selected purposively. The purpose was that, senior high schools that had low WASSCE pass rate in Integrated Science was the point of interest. Table 2 presents the WASSCE performance in Integrated Science from 2015 to 2018 in the selected schools.

Schools were stratified into programmes (General Science, Visual Art, General Agriculture, General Art, Business and Home Economics) and finally, a simple random sample was used to give each student an equal chance of being selected to partake in the study. Specific numbers of respondents were allocated for each class depending on the number of programmes offered in each school. The four hundred students who were selected randomly was appropriate for the researcher and it is supported by Krejcie and Morgan's table for determining sample size (Krejcie & Morgan, 1970). Table 3 presents the sample distribution of the respondents

A minimum of sixty students were chosen from each school to sum up to four hundred students. The selected students comprised of 52.5% males and 47.5% females whose average age was between 17 to 19 years. The students who were involved in this study were randomly selected from all the programmes offered in a particular senior high school; 60 students each from Visual Arts, General Science and General Arts; 80 students from General Agriculture; 70 students each from Business, and Home Economics were

randomly selected. All the programmes were used because Integrated Science is a core subject and students offered it as a compulsory course of study.

Workers in the schools were stratified into teaching and non-teaching staff. Using purposive sampling technique, teaching staff were selected and among the teaching staff, SHS 2 Integrated Science teachers were purposively selected because the study focused on SHS 2 students in Integrated Science. Also, three SHS 2 Integrated Science teachers were selected using simple random technique from each school making fifteen teachers, made up of 73% males and 27% females. The teaching experience of 27% teachers were from 1 year to 5 years, 46% teachers had teaching experience from 6 years to 11 years and 27% teachers also had teaching experience of 10 years and above. All the selected teachers had a degree in respective science areas such as chemistry, community nutrition, biochemistry, and physics. The selected teachers were interviewed on the factors that contribute to students' low performance in Integrated Science.

2.4 Data Collection Instruments

Questionnaire and interview guide were the research instruments used to collect data.

2.4.1 Questionnaire

The use of questionnaires ensured that unparalleled answers were obtained with the aim of building a relationship between the identified variables and the answers. There are a lot of factors that make students perform low in integrated science and the researcher sought to explore these factors. The students' questionnaire sought to answer questions on factors that influence low performance.

2.4.2 Interview Guide

The interview guide was used to comprehend the meaning of what the interviewees say (Kvale, 1994). The interview guide was designed for only teachers. The items on the interview guide were geared towards finding out the factors that contribute to students' low performance in Integrated Science.

2.5 Data Collection Procedures

Department of Science Education, University of Cape Coast issued an introductory letter to the researcher. With this letter, permission was received from the Ghana Education Service (GES) in Tamale to conduct research in the selected schools. The GES, Tamale prepared a letter which introduced the researcher, stated the purpose and asked to be allowed to conduct the research successfully. On the first day (Day 1) visit to the selected schools was only to distribute the permission letter from the Ghana Education Service in Tamale to the schools and seek permission from the Heads of the schools, Heads of school academics, Departmental Heads and also class teachers for the administration of the research instruments. On the second day (Day 2), a briefing section was organized with the science departmental heads, students, and teachers in the selected schools about the purpose of the study and how it will be accomplished. This was done to ensure that the

instruments are distributed properly and to the right respondents. The briefing section was also important to know the appropriate time to collect the data so that the study does not encounter any interruptions with school activities. The questionnaire was provided to the selected students at the schools for 5 days. The order of the schools that were visited was based on the day and times given by the heads of the science department. Some heads allowed the involved students to respond to the questionnaire in the class while others prepared the science laboratory for students to respond to questionnaires class by class. The questionnaire administration lasted between 15 to 20 minutes for each class. The questionnaires were collected on the same administration day.

Interviews were conducted using 15 randomly selected teachers from the selected schools. Available teachers were interviewed depending on the day and time scheduled to be at the school. In all 7 days were used for the teacher interviews in the five selected schools. The interview lasted for at least 20 minutes for each teacher.

2.6 Data Processing and Analysis

The questionnaires collected from respondents were analysed by coding closed-ended items and entered using data analysis software (Statistical Package for Service Solutions, SPSS). Exploratory factor analysis was used in analysing research question on the underlying factors that influence poor performance of Integrated Science students. Factor analysis was performed to reduce many individual items into a fewer number of dimensions and to identify latent variable. The outcome of the interview data of teachers was grouped using patterns and themes and interpreted qualitatively by the researcher to answer research the question.

3. Results and Discussion

Research Question: What are the underlying factors that influence students' low performance in Integrated Science in Tamale Metropolis?

3.1 Factors Influencing Low Performance

The Research Question sought to determine the underlying factors influencing student's low performance. There are numerous factors that affect students' performance in Integrated Science that the researcher wants to explore. An analysis of the exploratory factor was performed to determine the factors and to check if there were other latent factors. To be able to achieve this, students responded to a questionnaire and the scores were analysed using exploratory factor approach. Initially the scores from the questionnaire were subjected to Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. The KMO measure for sample adequacy is a figure that indicates the degree of variance in the variables that can be caused by the underlying factors.

The calculated KMO measure of sample adequacy was 0.810 this means higher reliability value. The value therefore shows that the factors extracted in the factor analysis conducted account for very good amount of variance. Bartlett's test of sphericity tested

the idea that the merging matrix was a proprietary matrix. Significance (sig) level of less than 0.001 ($p = 0.000$, $df = 1830$) shows the sample merging matrix did not originate from a population in which the intercorrelation matrix is identical matrix (Friel, 2007). The results therefore show the sample correlation matrix did not originate from a population in which the intercorrelation matrix is identical matrix. This was an indication that the data from the questionnaire was suitable for factor analysis. To be able to extract the factors the principal component analysis was conducted. The results showing the initial eigenvalues and total variance explained by each factor are presented in Table 4.

Table 4 revealed the possible number of factors that may be extracted to explain the variations within the item responses and their corresponding Eigenvalues. It also showed the existence of nineteen items with Eigen values more than one. These factors together described approximately 61.129% of the variance. Explanation of 61.129% of the variance shows that there could be other factors. Therefore, the 19 factors revealed by the Kaiser criterion had no importance to this analysis. To explain the inapplicability of the nineteen factors showed in the analysis, a graphical representation called the scree plot was used to additionally extract the real factors. The scree plot is presented in Figure 2. The structure of the scree plot as proposed by Cattell's (1966) is a graph the of factors on the horizontal axis against the vertical axis which contained the eigenvalues (Cattell, 1966). According to Pallant (2007), the factors which are to be retained are those which are placed before the point at which the agreeing eigenvalues appear to be cut off. Figure 2 shows that a variation in the slope of the graph begins after factor five. There happens to be a relative variation in the steepness of the graph after the fifth factor hence the scree plot retained only five factors. Nevertheless, the scree plot in Figure 2 is much subjected therefore parallel analysis or repositioning on Microsoft Excel was done using initial eigenvalues above 1.

Figure 3 therefore shows the parallel analysis which was done. According to Horn (1965), parallel analysis makes the interpretation of scree plot more objective rather than subjective (Horn, 1965). The component numbers on the straight line and above a straight line indicates the number of factors to be kept. It has clearly given the interpretation that there are three factors to keep. The next result studied from the factor analysis was the table of communalities. It shows degree of variance in the responses that have been accounted for by the extracted factors. In the table of communalities, a high value means the items had a lot of common features and low values shows the items had few in common features. The table of communalities is shown in Table 5.

Communalities can be described as the sum of squared factor loadings for the variables. It can also be described as the quantity of each variable's variance that can be described by the underlying latent factors. Communality or common variance is associated with unique variance and both make up 100% of the variable's variance. Unique variance is classified as specific variance and error variance. Specific variance deals specifically with the models. Error variance deals with something fairly unrelated with the models. Error variance also comes from errors of measurements and basically anything unexplained by specific variance or common variance.

On the diagonal of the correlation matrix, the initial values are determined by the squared multiple correlation of the variable with other variables. Portion of each variable's variance that can be explained by the maintained factors is indicated by extraction values. Table 5 shows the degree of the variance that responses have been accounted for by the extracted factors. A high value in Table 5 simply shows that the items have a lot of features in common and low values meant that items have little features in common with each other. From Table 5, the loadings as exhibited correspond to the correlation between the items and their factors. Each item in Table 5 was examined for the factor on which the variable loads by using the absolute values of loadings. To aid the interpretation of the components to be retained, Varimax rotation was performed. The results are presented in Table 6.

The rotated solution as indicated in Table 6 shows three components indicating the loadings of each item. Based on the rotated solutions as presented in Table 6, five factors were initially deduced, however, two of these factors were rejected as they had only one item each loading on them. This is confirmed in the writings of Henson and Roberts (2006, p. 10) "*it is not necessary to retain all the factors as they do not contribute much to the overall solution*" (Henson & Roberts, 2006). This caused for three factors to be retained. It was noted from the factor analysis that when the three factors are used, some of the items had cross loadings which called for deletion. The cross loadings items have been labeled by bolding the item number, statements and components in Table 6. The factors consisted of 61 items but after exploratory factor analysis was performed, only 22 items were retained or had strong loadings. Though, 22 items were retained it does not entirely mean that the remaining factors was not important. Table 6 indicates that thirteen items that loaded substantially was given a theme (teacher attitude), looking at six items loadings it was also given a theme (school environmental factor) and three items loadings was also given a theme (student attitude). Three items were retained because according to Williams et al, at least two or three items must load on a factor before it can be retained (Williams, Onsman, & Brown, 2010).

A critical examination of Table 6 revealed that five items loaded highly on the theme, teacher attitude factor. The item with the highest loading was 'my teacher encourages us to ask questions in Integrated Science classes followed by 'my teacher motivates us to think critically'. This shows that teachers' encouragement and motivation is important for students' success in Integrated Science. The next highest is 'my teacher always prepares before Integrated Science lessons', then 'my teacher explains the objective of the lesson clearly at the start of each period' and finally, 'my teacher is always in class and on time during Integrated Science period'. These highlights aspects of teachers that are difficult to assess, but it is important for students' learning, includes the ability to transport ideas in convincing ways, creating active learning environments for different types of learners, promoting productive relationships between teachers and students, and effective collaboration with colleagues and parents (Akiba, LeTendre, & Scribner, 2007). However, difficult it may be, it influences the learning of students positively when concepts are clear to students (Akiba, LeTendre, & Scribner, 2007).

With regards to the theme, school environmental factor, the item that loaded highest was 'the science laboratory helps me to perform well in Integrated Science'. It means that science laboratory is very essential in students' performance in Integrated Science. The next higher item was 'the availability of ICT facilities helps me to learn'. Excerpt from the face-to-face interview with the integrated science teachers revealed that the school environmental factors influencing low performance of students in Integrated Science were: large class sizes, inadequate and outmoded textbooks, the loaded nature of the integrated science syllabus and difficulty in monitoring learning progress of students.

Three items were extracted for student attitude. The first item that loaded strongly was 'I do not enjoy reading so it is difficult to study Integrated Science', next was 'I do not ask questions in class because I am shy' and the item that loaded least was 'I mostly do not enjoy Integrated Science lessons. A cursory look at these items shows that students have positive attitudes towards reading and enjoying Integrated Science and must be encouraged so that their interest in Integrated Science will affect their performance positively as well.

The preceding analysis and results revealed that three factors (teacher attitude, school environmental factor and student attitude) are dominant with reference to factors influencing students' low performance in Integrated Science. In addition, the three factors that were maintained explained 24.033% of the variance. This shows that there are other factors apart from the three factors that influence student's performance. The factor analysis also showed cross loadings. This is an indication that the all the original items under the three factors did not measure the three factors exactly and this affirms that there are other factors aside the three factors that were mentioned. The factors found in the factor analysis have items loading on them could have features with similar measured characteristics between them. The communalities outcome indicated that what the factors have in common are quite large. It was anticipated that the items measuring the same construct would be loaded together on a particular factor. However, the item loadings revealed that three factors influence students' performance in Integrated Science. Reliability analysis was further performed on the dominant factors (22 factors) that were extracted. For teacher attitude factor which consisted of 13 items, the reliability coefficient was 0.815, school environmental factor which had 6 items has a reliability coefficient of 0.646 and student attitude factor which included 3 items had 0.538 as reliability coefficient. This exceeded the recommended value. According to Hinton, Brownlow, McMurray and Cozens (2004), a reliability test score of more than 0.90 is statistically excellent; 0.70 to 0.90 is high, 0.5 to 0.7 is moderate while below 0.50 indicates a low reliability (Perry Hinton, Hinton, McMurray, & Brownlow, 2004; Umar, Zawawi, Khamidi, & Idrus, 2012). The Barlett's Test of Sphericity also reached statistical significance (sig. value of 0.00) supporting the factorability of the correlation matrix.

The research question further examined the views of teachers on students' low performance in Integrated Science. Some of the responses from the teachers during the interview were themed as:

A. Teacher Attitude

Attitude is related to the personality of a person. Therefore, teacher attitude is the personality of a teacher in and outside the classroom. Teachers indicated the following; "*School bus is only used for students and during special occasions in the school, getting yolo yolo (a type of transport in Tamale) is difficult therefore I am mostly late to integrated science class"* (Integrated science teacher, 8 years of experience, School C). *"I do not stay close to the school. I have to travel more than 4 miles to and after school every day with a motor bike therefore enough preparation before Integrated Science lesson becomes difficult"* (Integrated science teacher, 6 years of teaching experience School B). The teachers also reported that some teachers were not qualified enough to teach integrated science, some teachers have low practical ability and cannot handle topics in integrated science very well, and some teachers are also not disciplined and committed to their work. Some of their responses are: *"Teachers are also to be blamed for poor performance students in Integrated Science because they cannot handle the practical aspect very well example preparation of gases"* (Integrated Science teacher, 12 years of teaching experience School C). *"Teachers need to be supervised well because they are not teaching well due to wrong mentality about just the salary not making an impact"* (Integrated Science teacher, 3 years of teaching experience, School D).

B. School Environmental Factor

The environment students experience is responsible for creating understanding of concepts and nourishing their creativity (Mege, 2014) to improve their performance in Integrated Science. School environmental factor includes the physical layout that is within or without the classroom as well as the unseen things that are done in a school to make students comfortable. The excerpts from the interview themed 'School environmental factor' are "*In the first place, there is inadequate classrooms hence large class size which makes teaching and classroom management difficult. Usually there are over 70 students per class. I teach 6 classes in total 70 multiplied by 6. Due to large class size giving class exercises and marking becomes difficult*." (Integrated Science teacher with 14 years of teaching experience, School E). "*Students use the mosque as their classrooms since it is not enclosed, they have divided attention and are attracted to noise making in the environment and on the road. When it is also time for prayers by the Muslims they are sacked, and this distracts learning of Integrated Science."* (Integrated Science teacher with 7 years teaching experience, School A). "*The problem is inadequate, outmoded and sometimes no integrated science textbooks to teach students. The integrated science syllabus is hard to complete because of a lot of extracurricular activities that reduces the instructional hours. The school is semi-boarding. So, it is difficult to monitor learning progress of students. Also, teachers have no accommodation on campus and cannot monitor students well. It is also difficult to organize extra classes for students after school or weekends. Students are not controlled in the night because few or no teacher has accommodation on the school premises therefore, they do not devote time in learning integrated science*." (Integrated Science Teacher with 15 years of teaching experience, School A, male).

C. Student Attitude

Student attitude is related to the personality of a student in and outside the classroom. It was revealed that absenteeism of students is very high, most students are not interested in learning especially Integrated Science, some females are mostly interested in marriage, lack basic knowledge in mathematics and English, and some students lack discipline from home because their parents do not involve themselves in their studies. Examples of their responses are: *"Students in this part of the Region are the "bread winners of their families". They have their own business and work to support themselves and the family this is why they come to school when they want"*(Integrated science teacher, school A; Integrated Science teacher school E) , "*I partly blame the culture and their religion, they believe marriage fulfills half of their religion so some of the females carry that and are just not interested in learning*" (Integrated Science teacher, School A) and *"Most students cannot read and write well therefore it becomes difficult to teach them integrated science content. Example; some have aggregate 50 and are in the science class. Students have low grade from Junior High School, so it is sometimes difficult to cope with learning at the SHS level"* (Integrated Science teacher, school B; school C).

The results from both teachers and students showed that there are mainly three factors that contribute to students' low performance in Integrated Science. The factors were teacher attitude factor, student attitude factor and school environmental factor. This is no surprise as it was part of the five factors Adane reported in his study (Adane, 2013). Adane (2013) mentioned teacher related factor, student related factor and school related factor as part of the factors affecting Integrated Science in Ghana. Also, the items that loaded strongly on the teacher attitude factor were encouragement to ask questions in class and motivation to think critically. Shulman et al, indicated that quality teachers demonstrate commitment, encourages students, and facilitates the acquisition of student's higher order thinking level (Co-operation & Development, 1999; Shulman, 1986). Teachers should be mentors who motivates students to think critically and have creative problem-solving skills whether in the classroom or outside. The researcher agrees with Akiba et al, that accomplished teachers of Integrated Science are coaches and open minded therefore should encourage students to ask questions in class and share ideas together (Akiba, LeTendre, & Scribner, 2007). This will make student comfortable in class, confidence in Integrated Science and will be able to apply knowledge acquired easily. The item that has highest loading for environmental factor was availability of science laboratory. Science laboratory and resources is important in studying especially because it gives students hands on experience (Mege, 2014). Also, lacking mentally stimulating facilities in schools is very destructive to studies and performance. The adequate and furnished science laboratory should be a priority in building students (Danesty, 2004). 'I do not enjoy reading so it is difficult to study Integrated Science' is the item that loaded highest on the student attitude factor. Engin-Demir et al. (2009) mentioned that the amount of time students invests with books have significant impact on their performance. It is crucial for students to allocate time reading books to make Integrated Science easy (Engin-Demir, 2009).

4. Conclusion and Recommendation

The study has shown that factors that affect low performance of students in Integrated Science in the Tamale Metropolis are school environmental factor, teacher attitude and student attitude. Inadequate physical facilities such as science laboratory, ICT facilities, school library and inadequate instructional materials are some of the perceived school environmental factors. In as much as school environmental factors contribute to students' low performance in Integrated Science, students and teacher have a share in low performance due to the attitudes they possess in and outside school.

It is recommended that School environmental factors such as provision of adequate ICT lab, science lab and textbooks should be made available by the Ministry of Education to schools in the Tamale Metropolis since they were inadequate in the schools selected and perceived to have contributed to students' low performance in Integrated Science. Departmental heads should monitor and supervise teachers and students as teacher and student attitude towards Integrated Science lessons was not positive. The heads of the selected schools through the guidance and counseling unit should also organize programmes that will create awareness of the importance of Integrated Science to students. This is because student attitude such as lack of interest in Integrated Science was found to contribute to students' low performance.

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Conflict of Interest Statement
The authors declare no conflicts of interest.

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Appendix 1: Figures and Titles

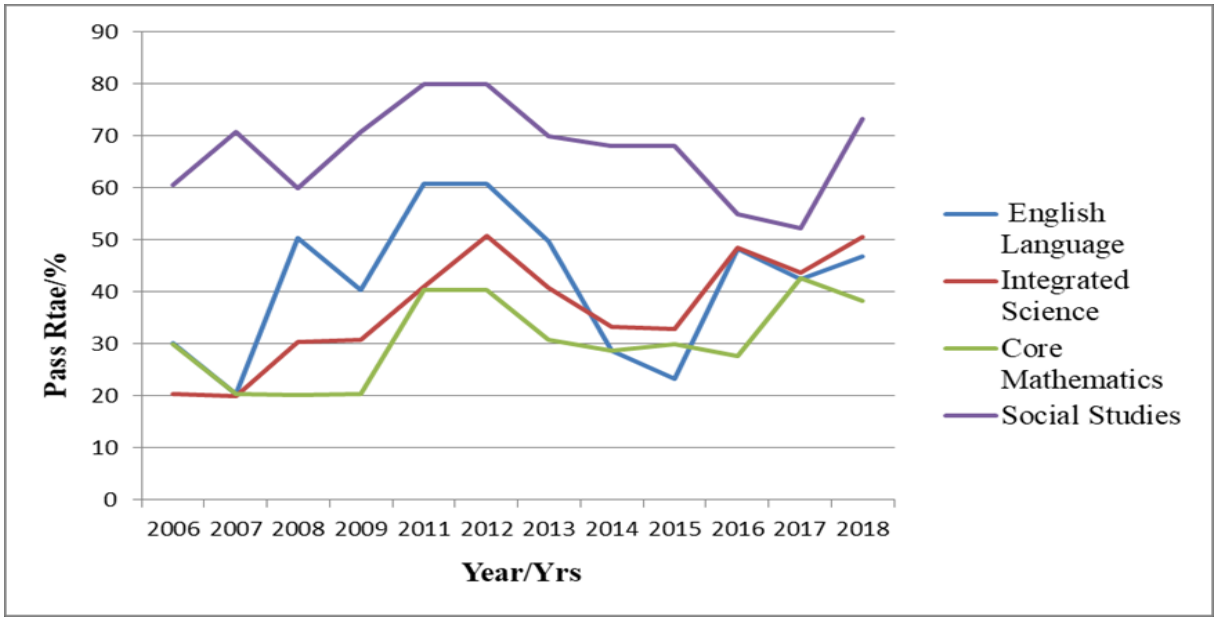

Figure 1: WASSCE pass rates (A1-C6) in core subjects, 2006-2018

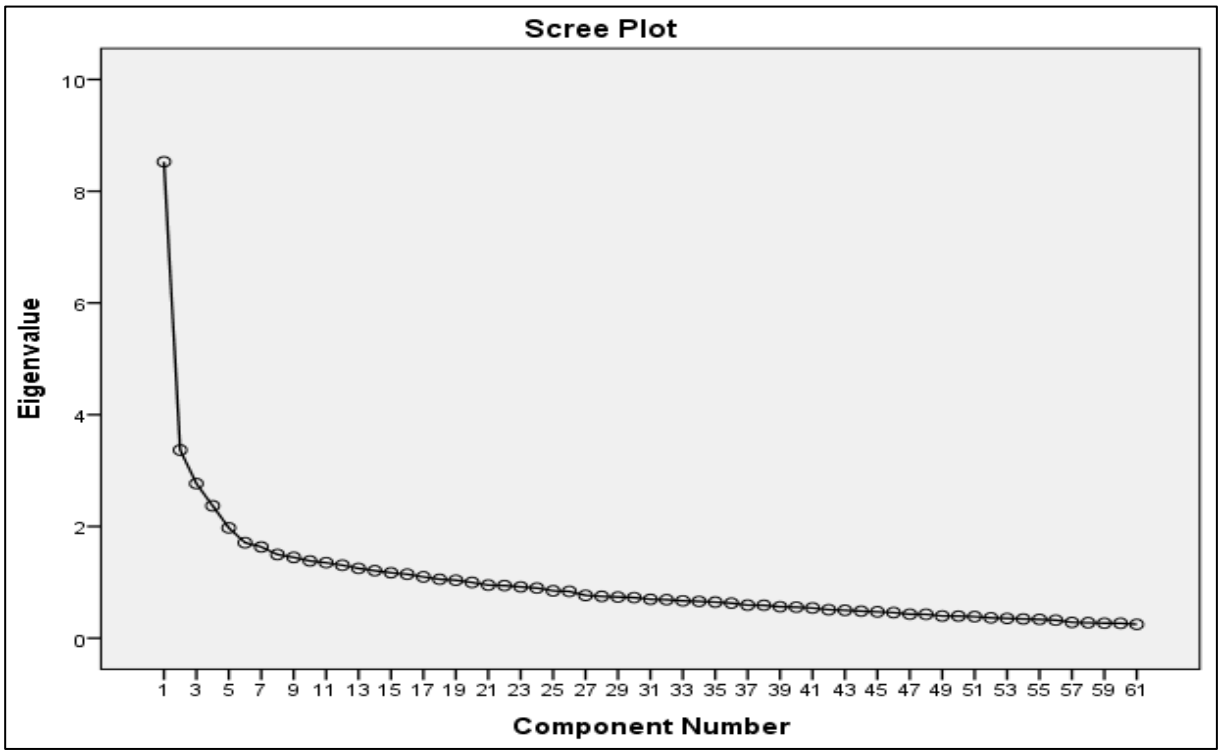

Figure 2: Scree plot showing number of factors

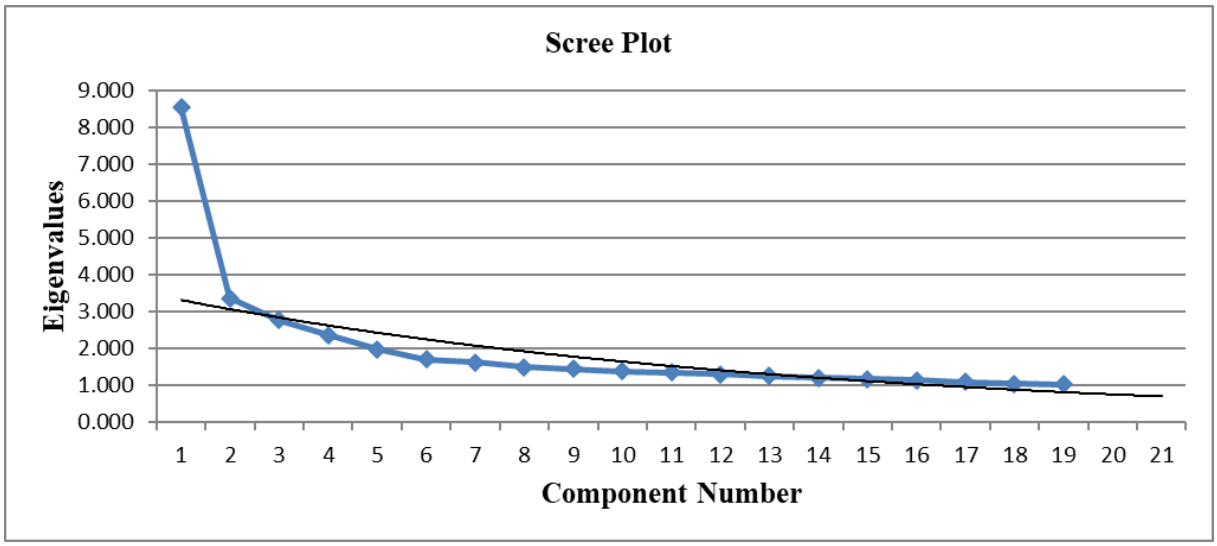

Figure 3: Parallel analysis of scree plot showing number of factors that were retained

Appendix 2: Tables

Table 1: WASSCE Pass Rate (A1 to C6) of Integrated Science by Region from 2013 to 2017

Regions	**2013**	**2014**	**2015**	**2016**	**2017**
Greater Accra	49.44	28.77	26.20	50.51	39.90
Eastern	55.77	26.82	21.84	53.52	43.24
Central	52.23	23.77	24.18	47.60	43.09
Western	51.06	30.03	24.86	53.68	51.03
Ashanti	47.08	35.51	31.63	58.37	48.52
Brong Ahafo	56.08	45.88	25.71	56.44	68.87
Volta	46.33	19.21	16.05	39.03	31.45
Northern	33.97	11.25	10.32	21.92	17.04
Upper East	53.68	16.61	10.74	32.80	21.35
Upper West	63.84	25.06	20.53	40.03	29.97

Source: (WAEC, 2018).

Table 2: Performance of Selected Schools in WASSCE Integrated Science from 2015 to 2018

School	**Year**	**N**		**N**
		A1–C6	**D7-F9**	
School A	2015	0	151	151
	2016	13	238	251
	2017	27	539	567
	2018	25	551	576
School B	2015	41	442	486
	2016	156	408	566
	2017	120	361	483
	2018	55	424	482
School C	2015	-	-	-
	2016	306	226	531
	2017	223	287	520
	2018	230	434	668
School D	2015	-	-	-
	2016	72	209	283
	2017	19	377	384
	2018	35	173	208
School E	2015	-	-	-
	2016	-	-	-
	2017	58	403	461
	2018	67	390	457

Note: n is the number of students who obtained various grades; N is the total number of registered students from each school

Table 3: Sample Distribution of Respondents

Schools	**N**	**%**		**N**		**%**
School A	100	25		3		*20*
School B	60	15		3		*20*
School C	100	25		3		*20*
School D	80	20		3		*20*
School E	60	15		3		*20*
Total	**400**	**100**		**15**		**100**

Note: n is the number of sampled students; N is the number of sampled teachers; % is the percentage of sample.

Table 4: Initial Eigenvalues and Total Variance Explained by Each of the Factors Component Initial Eigenvalues Rotation Sums of Squared Loadings

	Total	**% of variance**	**Cumulative %**	**Total**	**% of variance**	***Cumulative %***
1	8.527	13.978	13.978	7.496	12.288	*12.288*
2	3.367	5.520	19.499	3.798	6.226	*18.514*
3	2.766	4.534	24.033	3.367	5.519	*24.033*
4	2.369	3.884	27.917			
5	1.974	3.236	31.153			
6	1.709	2.802	33.955			
7	1.633	2.677	36.631			
8	1.497	2.454	39.085			
9	1.446	2.370	41.455			
10	1.383	2.267	43.722			
11	1.351	2.215	45.927			
12	1.306	2.140	48.077			
13	1.250	2.048	50.125			
14	1.208	1.981	52.106			
15	1.171	1.919	54.025			
16	1.145	1.877	55.903			
17	1.097	1.798	57.701			
18	1.054	1.728	59.429			
19	*1.37*	*1.700*	*61.129*			

Table 5: Communalities

Item number	Initial	*Extraction*
1	1.000	*.083*
2	1.000	*.267*
3	1.000	*.101*
4	1.000	*.119*
5	1.000	*.313*
6	1.000	*.200*
7	1.000	*.255*
8	1.000	*.140*
9	1.000	*.092*
10	1.000	*.161*
11	1.000	*.087*
12	1.000	*.229*
13	1.000	*.048*
14	1.000	*.124*
15	1.000	*.395*
16	1.000	*.395*
17	1.000	*.140*
18	1.000	*.244*
19	*1.000*	*.376*

Table 6a: Factor analysis showing loadings of each item

Item number	Statement	Component		
		1	2	3
33	My teacher encourages us to ask questions in Integrated Science	.694		
34	My teacher motivates us to think critically	.655		
29	My teacher always prepares before Integrated Science	.651		
38	My teacher explains the objective of the lesson clearly at the start of each period	.631		
31	My teacher is always in class and on time during Integrated Science period	.615		
49	I enjoy Integrated Science class	.597		
27	**My teacher presents concept in such a way as to make Integrated Science clearer to me**	**.590**	**.161**	
48	My teacher uses examples in our surrounding to explain Integrated Science lessons to us	.580		
47	**My teacher motivates us to pay attention in class**	**.579**		**.129**
30	My teacher is open to suggestions and opinions of students	.515		
36	**My teacher uses recommended textbooks to teach Integrated Science**	**.511**	**.139**	
50	**I pay attention in class during Integrated Science lesson**	**.503**	**.116**	**.154**
37	**My teacher mostly gives class exercise right after teaching a topic**	**.474**	**.225**	
32	My teacher leaves class when his/her time is up	.463		
41	**My teacher marks class exercise on time and discuss with students**	**.441**	**.192**	
42	**When we say we do not understand a particular topic, my teacher teaches it again till we understand**	**.441**		**.105**
28	**My teacher involves students in the lesson most of the time**	**.440**		**-.122**
46	My teacher is a trained Integrated Science teacher	.437		
35	My teacher uses two or more textbooks to teach Integrated Science	.355		
56	**Practical and theory helps me to understand Integrated Science well**	**.343**	**.208**	
39	My teacher combines practical and theory when teaching Integrated Science	.342		

16	**I perfectly understand the medium of instruction (English) used to teach Integrated Science**	**.331**	**.166**	
18	**The types of reward and punishment used in Integrated Science makes me learn well**	**.315**	**.176**	**.176**
22	**Class work and homework helps me to perform well in the end of term examination**	**.304**	**.175**	
40	**My teacher's good interpersonal relationship with me tends to affect my performance positively**	**.282**	**.157**	**.158**
26	The school has playing field that gives me co-curricular development		.490	
20	**There are enough classroom tables and chairs for us to use when studying Integrated Science**		**.452**	**.157**
14	Availability of recommended textbooks enhances my performance		.441	
55	**I alert my teacher immediately if I do not understand a topic Integrated Science**	**.228**	**.387**	**-.303**
54	**I get worried when my Integrated Science teacher is absent in class**	**.351**	**.361**	
60	**I study before Integrated Science class starts**	**.238**	**.337**	**-.149**
58	**I use two or more Integrated Science textbooks to learn**	.180	.334	-.271
61	**help my classmates who have difficulty in learning Integrated Science**	.198	.306	.218
11	**The use of up-to-date books makes me learn Integrated Science well**	.166	.268	
19	**My school location is good for learning Integrated Science**	.116	.265	
59	**I prefer teacher's notebook to textbook when I am learning Integrated Science**	.185	.247	
21	I easily adapt to change in terms of new teaching method		210	
9	**I use two or more Integrated Science textbooks to learn**			
68	**I do not have enough time to study Integrated Science well**		**-.175**	**.621**
51	I do not ask questions in class because I am shy			.578
52	**I am afraid to ask questions because my classmates will laugh at me**		**-.148**	**.548**
64	I mostly do not enjoy Integrated Science lessons			.479
57	**I use only one Integrated Science textbook to learn**		**-.102**	**.470**
45	**If my teacher is unable to complete selected topics for the term it affects my performance**		**.132**	**.426**
53	**I frequently ask questions in class to understand Integrated Science**	**.274**	**.329**	**-404**
66	**My lateness to school makes me perform poorly**	**.188**	**.172**	**.383**
44	**My teacher's absence from school on a regular basis affect my performance negatively**		**.155**	**.353**
65	**Absenting myself from school on a regular basis makes me perform poorly in Integrated Science**	**.192**	**213**	**.336**
25	**I understand Integrated Science better when the local language is mixed with English in class**			
17	When I ask questions in class, it enhances my understanding and performance in Integrated Science	**.190**	**.104**	**.212**
53	**My teacher provides help in learning activities**	**.462**		
43	**I get worried when Integrated Science lesson is being interrupted**	**.455**	**.145**	
62	The science laboratory helps me to learn Integrated Science	**.203**	**.100**	
23	Availability of ICT facilities helps me to learn Integrated Science		.626	
24	**Sanitary facilities in school are good and enough, this makes me feel comfortable in school**		.623	
13	The library in my school helps me study Integrated Science well		**.524**	**.106**
10	**The school environment (school building, administrators, peers and teachers) motivates me to learn**		.512	
12	**The use of local language more than official language (English) helps me understand Integrated Science better**	**.123**	**.321**	
63	**I understand Integrated Science better when the local language is mixed with English in class**	**.171**	**.333**	

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