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Research Article

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An Interplay of Gender, School Type, and Grade Level on Senior High School Students' Interest in Learning Science

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Abstract

Students' interest in learning is one of the critical elements of learning science in high schools, with students likely to opt out of the general science program when the opportunity is given. Consequently, students' interest is reported to be affected by several factors, such as the gender of students. In a cross-sectional survey research design, using quantitative approaches where an interplay of variables was possible, the researchers contributed to the literature on students' interest in learning science by examining the combined effect of gender, school type, and grade level. Using multistage sampling procedures, 250 first-year, 186 second-year, and 306 third-year students, all in a ratio of one male to one female were selected to respond to the Questionnaire on Students' Interest in Science. Through factorial ANOVA it was established that there was no interaction effect of gender across school type and grade level on students' interest in learning science. In furtherance to the no interaction effect, the main effect of gender and students' interest as well as school type and grade level, with post-hoc comparisons using the Bonferroni test on high school students' interest and grade level. The implications of the findings are discussed to inform policy, research, practice, and decision-making.

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Introduction

The search for an understanding of how to get high school students interested in learning science has been given considerable attention for some decades now (Adu-Gyamfi, 2013; Boukayoua et al., 2021; Burkam et al., 1997; Jones et al., 1999; Ogundola et al., 2020). Such considerable attention could have been given because interest is a significant factor in a student's decision to pursue a profession in science (Drechsel et al., 2011). This point was buttressed in today's literature by Steidtmann et al. (2023) that one primary reason fewer basic school students choose science courses in school education is a lack of interest in the subject.

However, Hasni and Potvin (2015) noted that the concept of interest is multidimensional and can be explained in three dimensions. That is, knowledge (being the cognitive feature), emotional (being the affective), and value and importance (being the value-related features). While the value-related component is concerned with attributions of personal significance to the object of interest, the feeling-related component refers to the pleasant affective experiences surrounding interest-driven activities (Trobst et al., 2016). The cognitive and affective components are activated in response to an individual's environment (Hidi & Harackiewicz, 2000).

Thus, interest is interactive and explains the relationship between individuals and parts of their environment (Hidi & Harackiewicz, 2000). That is, interest could be situational or personal (individual) (Bernacki et al., 2016; Hidi & Harackiewicz, 2000) whereas the situational is an automatic response by the individual to features of the environment (Harackiewicz et al., 2008), the personal is dispositional, associated with what the individual prefers, his or her increased knowledge of a particular subject or the value and positive feelings he or she has for the subject. This type of interest is long-lasting (Renninger, 2000) and is described by Harackiewicz et al. (2008) as a deep and enduring disposition.

We can transform situational interest into individual interest (Harackiewicz et al.,2008; Palmer et al., 2017) to the benefit of the student (Harackiewicz et al., 2008). That is, drawing on both frameworks, we proposed that if classroom factors (such as teaching style and meaningful course materials) contribute to the construction of meaning and value, the situational interest that may arise would be maintained over time and beyond a certain situation, and it would be associated with the accumulation of knowledge about the topic. Consequently, individual interest will be deepening. This relationship between individual and situational interest has been empirically tested in an intervention study to improve students' interest by Bernacki et al. (2015), reporting increases in situational interest predict higher individual interest.

The kind of interest students develop in a subject, such as science, is linked to the experience or prior knowledge of students (Harackiewicz et al., 2008) and how the content is related to their everyday lives (Djudin, 2018). Harackiewicz et al. (2008) explained further that students may develop an individual interest in the subject because of their prior experience with materials relating to the subject, and usually, in this context, they may develop a deeper interest. Another way is that students begin a course (subject) with limited knowledge and little initial interest in it but later develop interest during the course (subject), especially if the nature of the course (subject) is such that they can comprehend, and the teacher or course materials stimulate students' attention and involvement. Such interest may be situational but when it endures it becomes individual and consequently leads to better academic performance. According to Djudin (2018), if the science concepts are related to real-life experience, students will see their relevance and that will help develop their interest.

The type of instructional strategies adopted by science teachers play a role in getting students interested in learning science (Palmer, 2009; Toli & Kallery, 2021). Trobst et al. (2016) made a point that changes in the way science is taught may be a significant factor in students' declining interest in science, in addition to more general developmental trends. That is, engaging students in experiments is typically thought to stimulate enthusiasm in science and by this active participation in practical tasks, their future interest in science is influenced. Toli and Kallery (2021) looked at enhancing students' interest to promote learning using the concept of energy as a case study. In this study, 110 students were assigned to the experimental group and 96 students to the control group. The experimental group was exposed to a series of hands-on activities, both manual and computer software, and found the interest of students in the experimental group to have significantly increased than that of the students in the control group. The study reported a positive significant correlation to exist between students' academic achievement and interest in learning science. To this end, Toli and Kallery (2021) agreed with the literature that the use of technological software, experiments, and other hands-on activities are vital sources from which science teachers get students to develop an interest in learning science.

On the contrary, Djudin (2018) pointed out that the lack of student interest may not be revitalized merely through employing technology-based teaching, learning through the application of projects, an increase in human context, or making connections among different curricula, and showing the employment of science concepts in the future. Rather, science teachers' personal interests through to students' situational interests could be revitalized through content, context, and a combination of both [context and content] learning activities. House (2009) appeared to agree with Djudin (2018) that it is not just choosing instructional strategies but choosing instructional strategies that present science material in contexts that are both directly relevant and familiar to the student for practice. In this way, society can be sure students' interest in science would be supported. For the relevance of context and content in students' interest in science, Trobst et al. (2016) asserted that a heuristic set of instructional strategies that can plausibly increase students' interest in science are making use of examples from everyday contexts, providing clarity, eliciting student explanations, and using student experiments.

More so, one thing that needs to be given much more attention is the lack of interest (Adu-Gyamfi, 2013) and perhaps academic motivation, causing students to neglect their studies (Hidi & Harackiewicz, 2000). Students' interest in science, in general, and specific science-related subjects is on the decline (Djudin, 2018; OECD, 2018; Steidtmann et al., 2023) and this decline heightens as students age (Hidi & Harackiewicz, 2000). Also, research seems to suggest that weak grades of students in science are critical stages of the development of interest but as they transition to the level, their interest declines (Steidtmann et al., 2023). Trobst et al. (2016) asserted that there is ample proof that students lose academic interest as they move from elementary to secondary school, and this decline is especially pronounced in the case of science education.

Thus far, the literature points out that students engage in the learning process and learn more when it interests them. Besides, the interest of students can be a predictor of the quality of learning science-related subjects and the level of current and future engagement. Also, a student's interest relates to academic success, and career aspirations, enabling him or her to put more effort into the learning (Boukayoua et al., 2021). The interest of students has also been found to relate strongly to attention, goals, and levels of learning (Hidi & Renninger, 2006) and explains the perception students will have about science. For instance, in studying attitudes and perceptions of 1564 grade 10 students towards teaching science and school science, Ebenezer and Zoller (1993) reported that 72% considered science valuable and 73% considered science in schools important, but 40% found science classes boring. It is also well-established that students who are interested in particular activities pay closer attention, persist longer, and learn more than individuals without interest in said activities (Bernacki et al., 2015; Hidi & Harackiewicz, 2000). Understanding ways of triggering students' interest in science will enable them to develop an individual interest.

In that regard, for the past decades, considerable efforts have been made by researchers to identify the possible indicators that predict students' interest in science learning (Adu-Gyamfi, 2013; Cheung, 2017; Toli & Kallery, 2021). For instance, Adu-Gyamfi (2013) in studying 259 male and female non- science students' lack of interest found students lack interests in school science was influenced by increased time demands on students' science learning, theoretical-based teaching and learning science, inability of science students being admitted into institutions of higher education, voluminous nature of scientific concepts, employing teaching strategies that lead to direct transmission of science knowledge from science teachers to students, unavailable scholarship schemes for students offering science, and difficult and challenging nature of science contents. Similarly, through structural equation modeling, Cheung (2017) found the self-concept of science, the interest of individual students, and situations in science lessons to be the strongest factors that affect students' interest in science lessons whereas gender and grade level happened to be factors that non-significantly influence students' science learning in schools (Cheung, 2017). In the research, how to cultivate students' interest in Physics, Djudin (2018) concluded that students' lack of familiarity with physics, perception of physics by extension science as the most difficult subject, the fact that most school science courses require a lot of memorizations, and their admitted concern about failing the class are the key factors that influence students' disinterest in science. Hidi and Harackiewicz (2000) asserted that two things may hinder students' performance in science: the students' lack of ability and their lack of interest. Science teachers do not have much control over the student's lack of ability but can influence the lack of interest. The factors surrounding the student's lack of interest such as schoolwork being too difficult or boring, science teachers being too demanding, and preference for non-academic activities are below the science teacher's reach.

Whether high school students' interest in learning science has an association with gender, grade level, and school type has been another area of concern. Thus, considerable attention has been paid to understanding the relationship between these in terms of interest in learning science (Akpınar et al., 2009; Boukayoua et al., 2021; Jia et al., 2020; Jones et al., 1999; Kristyasari et al., 2018; Ogundola et al., 2020). Consequently, to address this research gap, this research sought to examine an interplay of gender, school type, and grade level on students' interest in learning science. The research question that guided this study was:

How is the interest of male and female students in learning science affected by the school type and grade level?

Literature Review

Gender and Interest in Learning Science

One of the areas of literature review was gender and interest in learning science. With respect to gender and interest in learning science, Boukayoua et al. (2021) noted that gender differences significantly influence learners' perceptions, experiences, and attitudes toward courses and careers in science. Ogundola et al. (2020) found that females did not differ in their achievement scores from that of males but found that a significant difference existed in the mean interest and retention scores of students based on gender. This difference also exists in the domain specifics of science. For instance, in examining the responses of 210 English students, Direito et al. (2017) found that females are more interested in biology and less interested in physics than males; and that their self-concept regarding science subjects is significantly lower, suggesting that self-concept is an influencing factor for female students' interest in science, but not for males. Also, Adu-Gyamfi (2013) found non-science male and female students' mean scores to be significantly different statistically about their lack of interest in learning science. Using 600 students, Glory and Ihenko (2017) found students' interests to be influenced significantly by gender but students' achievements in integrated science are not significantly influenced by gender. However, Conel (2021) found no significant relationship existed between science interests and students' gender. It, thus, appears that further studies need to be done although much of the literature points to the fact that gender influences students' interest in science learning.

Grade Level and Interest in Learning Science

In addition, Jia et al. (2020) studied science achievement, interest, and creativity among others using 112,314 grade 4 students and 74,808 grade 8 students, reporting no gender difference in science academic achievement in both grade 4 and grade 8. However, there were varied scientific interests of grades 4 and 8 students in the different grades and disciplines with females having a higher interest in science in grade 4 and a higher interest in biology in grade 8 and the grade 8 males having much higher creativity than females, and males had significantly greater variabilities in interest whereas females had slightly greater variability in creativity. Similarly, Akpınar et al. (2009) found female students' interest in science learning to be significantly different and higher than their colleague males but also differences among students in different grade levels towards learning of science. In a quasi-experimental and longitudinal design covering grades 5-7, Steidtmann et al. (2023) found students interest in science learning to decline significantly, decreasing along grade level from grade 5 to 7, the decline becoming stronger from grade 5 to 6 than from grade 6 to 7.

School-type and Interest in Learning Science

Another area of literature review in this research was school type and interest in learning science in high school. With respect to students' interests and school type, Conel (2021) mentioned from a study of 100 junior high school students in public and private school settings that students showed favorable perception and interest in learning science. That is, among other variables, there was a significant relationship between students' interest in science and their age and school type, and age and gender was found to be good predictors of a student's interest in learning science.

Despite these elaborate works on these areas, none of them has attempted to study how all three variables interplay concerning students' interest in learning science. While gender and interest in learning science have been looked at (Boukayoua et al., 2021; Conel, 2021; Direito et al., 2017; Glory & Ihenko, 2017; Ogundola et al., 2020), grade level and interest have also been studied (Jia et al., 2020; Steidtmann et al., 2023), yet school-type and interest have been explored a little (Conel, 2021). Ogundola et al. (2020) opined that quality instruction increases enrollment; thus we must ensure that both males and females are completely able to benefit from education and that four aspects will be addressed if we use a method that considers the interactions and relationships between males and females. That is equal access, equal participation in the educational process, equal academic achievements, and equal external results. This far, examining the influence of gender, school type, and grade level in a single study will help contribute to literature by providing empirical evidence.

Theoretical Framework on Students' Interest in Learning Science

As mentioned earlier, understanding students' interest in learning science is crucial for educators, researchers, and policymakers. Interest in science significantly influences students' academic performance, engagement, and future career choices (Bennett & Lubben, 2006). Consequently, this theoretical framework looks at various theories to set up the basis for analysing students' interest in learning science. Several theories of student interest in learning have been espoused including Self-Determination Theory ((Deci et al., 2017; Ryan & Deci, 2017; Ryan & Deci, 2000), Expectancy-Value Theory (Eccles & Wigfield, 2002; 2024), and Social Cognitive Theory (Bandura, 1986; Piaget, 1973; Vygotsky, 1978), and IDC-Theory (Wong, et al., 2020). Though these theories appear difficult to integrate as they try to charter separate paths (Urhahne & Wijnia, 2023), their similarities lie in their convergence on suggestions of ways of developing students' interest in learning.

Concerning self-determination theory, motivation is driven by the need for autonomy, competence, and relatedness (Bandhu, et al. 2024; Ryan & Deci, 2000). Ng (2024) explained that competence involves achieving one's full potential, relatedness involves a sense of community connection, and autonomy is the driving force behind decision-making behavior. That is, self-determination theory draws our attention to the essence of providing more autonomy-supportive environments as such environment heightens students' intrinsic motivation and consequently high academic performance (Ng, et al. 2015). In an autonomy-supporting environment, the tone or milieu of the learning climate or the instructional practices is used to promote students' intrinsic motivation to learn (Ng, 2024). To this end research has established that both intrinsic motivation (and enjoyment) and extrinsic motivation are essential for fostering student engagement in learning (Ryan & Deci, 2000). When students' learning environments are built around autonomy-supporting, it promotes their social-emotional learning and consequently makes them develop an interest in science.

In furtherance, related to students' interest in learning science is the expectancy-value theory, which suggests that students' motivation is influenced by their expectations of success and the value they place on the subject (Eccles & Wigfield, 2002; 2024). Eccles, et al. (1983) highlighted students' expectations of success in science and the value they assign to science-related activities influence their interest. Higher competency and perceived value correlate positively with student engagement in scientific learning. In addition, students' sense of identity plays a significant role. Carlone and Johnson (2007) argued that students' identification with science careers can profoundly affect their interest levels. Encouraging students to see themselves in scientific roles can enhance their engagement. Krapp's model of interest (2002) brought to the fold that interest is influenced by personal relevance, intrinsic motivation, and contextual factors, including the perceived value of science education.

Another theory that contributes to our analysis of students' interests is cognitive development theory. It emphasizes how students' cognitive abilities shape their understanding of scientific concepts. According to Piaget (1973), adolescents in high school are typically in the formal operational stage, which enables them to understand abstract concepts and engage in logical reasoning, and critical skills for scientific thinking. Additionally, Vygotsky's (1978) social development theory underscores the importance of social interactions and cultural tools in learning. Collaborative learning environments can enhance interest in science through peer interactions and social support. Further, social and contextual influences play a significant role in shaping students' attitudes toward science. Emphasizes on social learning theory that observational learning and modelling significantly affect students' engagement (Bandura, 1977; Nurhidayat & Handayaningrum, 2024). Influential figures such as science teachers, peers, and family can radically reshape a student's attitude toward science. Additionally, Bourdieu's (1986) concept of cultural capital suggests that students from different backgrounds may experience varying degrees of exposure to scientific knowledge and education, affecting their overall interest in learning science.

To this end, Bandura's self-efficacy needs to be given attention as far as students' science learning is concerned. Bandura's self-efficacy theory (1997) asserted that students who believe in their capabilities are more likely to engage in challenging learning experiences. Educational interventions that enhance self-efficacy can lead to increased interest in science. This is supported by achievement goal theory, as described by Ames (1992), which differentiates between mastery goals (focusing on learning and competence) and performance goals (focusing on demonstrating ability). High school students with mastery-oriented goals tend to exhibit higher interest in science

From these views expressed above on interest, effective teaching strategies will have a big influence on students' interest in science. As espoused by IDC theory, interest development revolves around three loops; triggering, immersing, and extending (Wong et al., 2020, p. 15). By triggering, instructional strategies need to activate learners' curiosity, it needs to be engaging to allow learners immersion and comprehensibility to achieve extension (Wong et al., 2020). Thus, active learning and investigation are key components of inquiry-based learning methodologies, which can raise students' motivation and level of interest, which need to be given consideration (Furtak et al., 2012; Minner et al., 2010). Additionally, students' perceptions of the value of science learning are improved when scientific concepts are connected to real-world problems, which can further pique interest (Sadler, et al. 2007). Hence, researchers use technology integration as the power to change teaching and stimulate students' interests by making science more engaging. In this regard, virtual laboratories and simulations are examples of digital tools that may inspire students and improve their educational experience (Gonzalez, et al. 2015). Consequently, in this research, students' interest is the motivation that drives students to learn science. Hence, the theoretical framework explored students' interest in scientific education, combining cognitive, motivational, social, contextual, and pedagogical perspectives. This adopted theoretical framework suggested addressing these variables can lead to more effective teaching techniques promoting students' interest and success in learning science.

Methodology

Research Design

This research used a cross-sectional survey design to examine the interaction of gender, school type, and grade level on students' interest in science learning in senior high school. In this design the gender of students was the main independent factor at two levels (male and female) and other independent factors were school type at three levels (well-endowed, endowed, and less-endowed schools), and grade levels at three levels (first-year, second-year, and third-year). Thus, the survey was conducted in one of the metropolises in Ghana with a good number of all school types. The schools were selected randomly, and the researchers spent 2 days in each school to survey students of all year groups with a questionnaire.

Sample and Sampling Procedures

This study was conducted at Cape Coast Metropolis in the Central Region of Ghana. There were 10 senior high schools within the metropolis during the 2023/2024 academic year. Cape Coast Metropolis was chosen for this study purposely due to the availability of all three school types (that is, categories A, B, and C schools) (Ministry of Education [MOE], 2010) in the metropolis. The categorization of the schools was based on availability and quality of infrastructure, school performance in external examinations, and quality of human resources. The Category A schools had a better share followed by Category B and then Category C. These category A, B, and C schools reflected well-endowed, endowed and less endowed schools respectively. The schools in Cape Coast Metropolis were purposely selected in part because students in all these schools had similar characteristics to students in schools in the other regions in Ghana. The high school students in all 10 schools were targeted for this research but the accessible population was students in the general science program (learning biology, chemistry, physics, and mathematics).

To select students as the unit of analysis in this research multi-stage sampling procedures were used. To begin with, a stratified random sampling technique was used to stratify the 10 schools into three school types: categories A, B, and C schools. Of the 10 schools, there were five Category A schools, two Category B schools, and three Category C schools. Thereafter, the 10 schools were further stratified into five single-sex and five coeducational schools. That is, there were three male single-sex schools and two female single-sex schools, where one school was simply randomly selected from each of the male and female single-sex schools. The two single-sex schools were category A schools. Both the category B schools were coeducational schools, and they were selected purposely for this research. The Category C schools were coeducational schools and two were simply randomly selected for this research. The basis of selecting two schools each of categories A, B, and C schools was to have only two Category B schools, which were coeducational schools involved in this research. This implied that six schools were involved in this research.

In the six schools, students were stratified into three grade levels (first-year, second-year, and third-year). In each school, 150 students were sampled from the three grade levels of an estimated student population of 260. However, there was sample mortality due to the non-availability of some groups of students during the period of data collection. In all, 250 first-year students, 186 second-year students, and 306 third-year students participated in the research, making a total of 742 students. Of the 742 students, 51.1% were males and 48.9% were females; 33.7% were in the first year, 25.1% were in the second year, and 41.2% were in the third year; and 34.1% were in Category A schools, 35.4% in Category B schools, and 30.5% in Category C schools. Also, the ages of students varied among themselves. That is, of the 742 students, 31.4% were in the age range of 10 to 15 years, 67.3% were in the age range of 16 to 20 years, and 1.3% were above 20 years.

Data Collection Instrument

For this research, the researchers developed a questionnaire; Questionnaire on Students' Interest in Science [QSIS]. QSIS was a research instrument. QSIS was in two sections, Section A and Section B. Section A sought for demographics (sex, age, grade levels, and school type) of the students. This gave a total of four items. Section B was structured on a 7-point Likert scale ranging from lowest interest (1) to highest interest (7). Initially, there were 54 items measuring students' interest in science. High school students' interest was measured along with learning science in the schools, teachers' teaching of science in the school, benefits of science to students and society, students' participation in science lessons, science teachers' assessment and feedback practices, and students' grades and difficulties in science-related subjects (Appendix A).

The items were constructed based on extensive reading of the literature on students' interest in learning science. Also, the years of experience of two of the researchers in teaching in senior high school contributed to the item construction. Thereafter, QSIS was pilot tested with 30 students in another metropolis leading to item analysis.

As part of standardization of the items, the items on QSIS were subjected to exploratory factor analysis. As part of the processes leading to the determination of the factors, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was found to be *.951* and Bartlett's test for sphericity *(13668.11*) being significant ($p < 0.01$, $df = 861$). Examination of kaiser criterion value of 1 and subsequent examination of the screw plot revealed five factors were worth retaining. To ascertain the retention of the five factors, parallel analysis was conducted, the results of which are presented in Table 1.

Table 1: Comparing Eigenvalues from PCA to Criterion values from PA.

Component number	Actual eigenvalue from PCA	Criterion value from parallel analysis	Decision
1	13.277	1.480	Accept
2	2.856	1.430	Accept
3	1.815	1.392	Accept
4	1.671	1.355	Accept
5	1.390	1.329	Accept
6	1.144	1.302	Reject

The results in Table 1 further confirmed that the five factors were worth retaining. To aid interpretation, varimax rotation was conducted (Pallant, 2007). From the varimax rotation, factor 1 (benefits of science to students and society) had nine items and contributed 31.6% of the variance explained, factor 2 (teacher instructional strategies) had nine items with 6.8% contribution, factor 3 (students' academic achievements) had nine items with a 4.3% explanation of variance; factor 4 (students' participation in lessons) had three items with 4.0% explanation of variance and factor 5 (students' support systems) had three items with 3.3% explanation of variance given a 50% cumulative explanation of variance. However, 12 items had factor loadings either below *.5* cross-loadings or negative loadings and thus, were dropped. Detailed factor loadings from the rotation are attached (Appendix A). The reliability coefficients of the five factors together with the overall Cronbach alpha value is shown in Table 2.

Table 2: Reliability coefficient of the Five Factors.

Factor	Cronbach's alpha reliability coefficient
1	.866
2	.879
3	.876
4	.766
5	.589
Overall reliability	.951

From Table 2, Cronbach's alpha reliability coefficient analysis was conducted and on deleting 12 items to have 42 items on QSIS, Cronbach's alpha reliability coefficient was calculated as *.95*. This confirmed to the researchers that QSIS was reliable for this research.

Data Collection Procedure

The researchers spent two days in each school during the data collection period moving from one grade level to another. During the data collection process, the researchers sought permission from the Headteachers and Heads of Departments of all the six participating schools. This helped to prevent any event or happenings in the schools that could disturb the data collection process. Thereafter, the researchers briefed the students on the relevance of the study to them concerning their learning science. Thereafter, a statement of confidentiality which was attached to the questionnaire was read out to the students. The students were told they were free to opt out if they were not interested in taking part in the research. To ensure the independence of observation of the questionnaire, the researchers administered QSIS to the students by themselves. This helped to have smooth data collection devoid of disturbances. In all, we spent 12 days collecting data from the students who spent approximately 60 minutes responding to QSIS as they participated in this research.

Data Processing and Analysis

The items on QSIS were cleaned by the researchers checking how completely each student had responded to the items. The items were then coded into statistical package software for data analysis. To examine whether there was an interplay of three factors of gender, school type, and grade level on students' interest in learning science a factorial analysis of variance (that is, factorial ANOVA) was adopted as the most appropriate statistic. Because gender was at two levels (male and female students), school type was at three levels (well-endowed, endowed, and less-endowed schools), and grade level was at three levels (first-year, second-year, and third-year).

Results

Nature of Students' Interest in Learning Science

To answer the research question- *how the interest of male and female students in learning science is affected by the school type and grade level?* - students' level of interest in learning science was determined. Students of 742 in number from three school types and three grade levels responded to the 38-item 7-point Likert-scale research instrument. From the 7-point Likert scale, a mean of 1.0-1.4 indicated lowest interest, 1.5-2.4 was lower interest, 2.5-3.4 was low interest, 3.5-4.4 was moderate, 4.5-5.4 was high interest, 5.5-6.4 was higher interest, and 6.5-7.0 was highest interest. The students' level of interest in learning science was established to be moderate. Because the students' interest mean score was *4.4* (*Std. = 1.97*). Since the standard deviation was larger, there was high variability in the interest of students in learning science in school. Because two-thirds of the students' interests were in the range of *2.43 to 6.37* and not entirely close to the center of the distribution of interest scores. Hence, moderate interest in learning science reflected the interest of selected students in this research.

To ensure the right statistics were used, mean scores were considered to help determine whether there was an interaction effect of males and females in students' interests in learning science. For this to be achieved, the variance of students' interest scores in learning science, being gender across school type and grade level was determined using Levene's test of equality. Results from Levene's test of the factorial ANOVA were significant at $p = .048$. This meant that the variance in students' interest in learning science was not equal. Consequently, a more stringent alpha level was set for the significance level at $p = .01$ for evaluating the statistics of this result (Pallant, 2007). Thereafter, a three-way ANOVA statistic was conducted on students' interest in learning science to examine whether there was an interaction effect of male and female students' interests in learning science across school types and grade levels. The results obtained are represented in Table 3.

Table 3: ANOVA of Male and Female Students' Interests in Learning Science by School Type and Grade Level.

Source	Type III Sum of Squares	df	Mean Square	F	p.	Partial Eta Squared
Corrected Model	100.102[a]	16	6.256	5.598	.000	.110
Intercept	6866.173	1	6866.173	6144.120	.000	.894
Gender	6.760	1	6.760	6.049	.014	.008
Grade level	46.291	2	23.145	20.711	.000	.054
School type	4.510	2	2.255	2.018	.134	.006
Gender* grade level	4.240	2	2.120	1.897	.151	.005
Gender * school type	8.121	2	4.061	3.634	.027	.010

Grade level* school type	11.373	4	2.843	2.544	.038	.014
Gender * grade level * school type	6.807	3	2.269	2.031	.108	.008
Error	810.202	725	1.118			
Total	15683.972	742				
Corrected Total	910.304	741				

*Not significant, p > .01

As observed in Table 3, a three-way ANOVA was conducted to examine the interaction effect between grade level, school type, and gender. The results showed the interaction effect between male and female students across school type and grade level was not statistically significant (*F(3, 725) = 2.031, p = .108*) on students' interest in learning science. However, there was statistical significance on the main effects for grade level (*F(2, 725) = 20.711, p < .001*) and gender (*F(1, 725) = 6.049, p = .014*). The effect sizes for grade level (*partial eta square = .054*) and gender were very small (*partial eta square = .008*). Because they explained only *5.4%* and *.8%* of the variances shared among first-, second-, and third-year students who were male and female students. There was, however, no significant main effect for school type (*F(2, 725) = 2.018, p =.134*). This implied that a student's interest in learning science was not influenced by whether the school is well endowed, endowed or less endowed.

Again, from the three-way ANOVA reported in Table 3, it was apparent that there was no a significant 2-way interaction of school type and grade level (*F(4, 725) = 2.54, p = .038*), school type and gender *(F(2, 725) = 3.63, p = .027)* as well as there was no interaction effect between gender and grade level as the two-way interaction between gender and grade level was not statistically significant *(F(4, 725) = 1.897 p = .151*). For grade level at first-year, second-year, and third-year which showed statistical significance in main effect, the means were examined by the researchers.

Table 4: Mean Interest of Students in Learning Science in Relation to Grade Level (N = 742)

Grade level	N	M	Std.
First-year	250	4.83	1.072
Second-year	186	4.24	1.105
Third-year	306	4.29	1.065

Table 4 shows that interest in learning science is higher in first-year (*M = 4.83, Std =1.072*) than in second-year (*M = 4.24, Std. = 1.105*) and third year (*M =4.29, Std. = 1.065*). That is, first-year students' interest in learning science was higher than second-year. Worthy of note was the rise in interest in learning science from second year to third year. To this end, there was a need to examine the multiple comparisons from the post hoc analysis to see if these differences reach statistical significance.

Table 5: Multiple Comparisons of Students' Interests in Learning Science by the Three Grade Levels.

Grade level		Mean Difference	Std. Error	p
First -year	Second -year	.588	.104	.000
	Third -year	.542	.092	.000
Second- year	First-year	-.588	.104	.000
	Third-year	-.046	.102	.889
Third -year	First-year	-.542	.092	.000
	Second-year	.046	.102	.889

Post-hoc comparisons using the Bonferroni test indicated that there was a statistically significant difference in students' interest in learning science between first-year (*M = 4.83, Std =1.072*) and second-year (*M = 4.24, Std = 1.105, p<.001*) with a mean difference of -*.588.* There was a statistically significant difference in students' interest in learning science between first-year (*M = 4.83, Std =1.072*) and third-year (M =4.29, Std = 1.065, *p<.001*) with a mean difference of -*.542*. Although the mean values indicated there was difference between second -year and third year students' interest in learning science, such difference did not reach statistical significance as the mean of second year (*M = 4.24, Std = 1.105)* and third year *(*M *=4.29, Std = 1.065, p=.889*) was not statistically significant. Concerning any gender differences among high school students' interest in learning science, the effect size (*.8%*) showed not much to talk about. That is, the researchers did not see the need to conduct a post hoc of multiple comparisons of male and female students' interest in learning science in relation first-year, second-year, and third-year groups, and the school types.

Discussion

Findings of male and female high school students' interest in learning science in the school is moderate in this study. This shows students' interest in learning science in upper-secondary school is neither low nor high but exists somehow that the science education community can take advantage of to nurture as an attempt to attract more students to science-related subjects and courses. The findings of this study are in line with the findings of Djudin (2018) and the OECD (2018) that students' interest in learning science is moderate, thus attention should be given to studies that consider the effect of students' interest in their learning of science (Adu-Gyamfi, 2013). Furthermore, the findings of this study have not only advanced the knowledge in existing literature (Adu-Gyamfi, 2013) that non-science students lack interest in learning science but have also shown that science students' interest in learning science is at a moderate level. Although students' interest in learning science is moderate, in this research, there is no interaction effect of students' gender across school type and grade level on their interest in learning science. That is, there is no net effect of gender across school types and grade level on students' interest in learning science. Thus, the moderate interest students have in learning science cannot be attributed to the combined effect of the student's gender, the type of school he/she attends, and the grade level he/she has attained. The implication thereof is that there are other factors that affect or could combine to affect the interest of students in learning science in schools and colleges. This research could not account for those factors; therefore, science educators and researchers could further investigate that.

Notwithstanding, there are main effects for gender with a negligible effect size and grade level with a moderate effect size but not for the school type. Hence, any difference in students' interest in learning science could not be the combined effect of gender across school type and grade level or school-type or grade level by gender or grade level by school type or school type by gender as mentioned earlier. Hence, in this research, any observed difference in students' interest in learning science is due to the main effect of grade level but not school type. This finding seems to suggest that students' interest in learning science is greatly influenced by gender and grade level. Consequently, attending a senior high school with all the human and material resources may not be the reason for students to like or dislike learning science. The findings of no main effect of school type on the interest of students in learning science could not support the work of Conel (2021), who reports school type as a predictor of students' interest in learning science.

The finding on students' interest in learning science in relation to the gender of students may be small in relation to the effect size but it does exist and cannot be overlooked. That is, female students could be said to be more interested in learning science compared to male students. This study has confirmed the work of Akpınar et al. (2009) that gender influences students' interest in learning science favoring female students. Thus, the continuous investigation of male and female students' interest in learning science is still relevant today and the debate is ongoing. If female students are showing more interest in learning science today, it could be described as positive in the direction of achieving the MDG4 and SDG5, where the world seeks to achieve gender equality in areas, such as education (including science education). Additionally, female students on higher interest than their colleague males reaffirm the reports of Adu-Gyamfi (2013) and Glory and Ihenko (2017) that gender has a significant influence on students' interest in learning with males showing a lack of interest (Adu-Gyamfi, 2013) and disagrees with the report of Conel (2021) that there is no significant relationship existing between science interests and students' gender.

With regards to the findings on the main effects of grade levels on students' interest in learning science, there is a statistically significant difference among the three grade levels (first-year, second-year, and third-year), it can be inferred that students' interest in learning fade as they progress through the years of learning science-related subjects and experiencing different instructional strategies, assessment procedures, and teacher-student relationships. These experiences may not have positively contributed to the interest of students in learning science in school. It could also be that science teachers may not have managed the transition of students into learning science content that is considered difficult for students very well. Hence, the Ghana Education Service through the managers of schools should organize professional development programs that will enhance the managerial skills of science teachers to attract students' interest in learning science-related subjects. This finding that first-year students are of reasonable interest in learning science compared to second-year and third-year students is consistent with the reports of Steidtmann et al. (2023) and Trobst et al. (2016) that students' academic interest declines as they move from one grade level to another, especially in science education. This could be a challenge to curriculum planners, educators, and researchers in science education to look for more plausible ways of sustaining the interest of students in learning science as the years unfold.

Conclusions and Implications

In this research, the researchers studied the interest of students in learning science in senior high school. Quantitative approaches such as cross-sectional survey and factorial ANOVA were used to examine the combined effect of gender, school type, and grade level on the interest of 742 students in learning science. An important area though lacking in the literature on the combined effect of gender, school type, and grade level on students' interest in learning science. Hence, this research has added to the literature that there is no combined effect of gender across school type and grade level on the interest of students in learning science in high school. However, there is a main effect of gender on students' interest in learning science though being small in relation to the shared variances among female and male students. Though there is no main effect of school type (well-endowed, endowed, and less-endowed schools) on the interest of students in learning science, the years of having experienced learning of science-related subjects in school have a main effect on students' interest in learning science. Also, though students have a moderate interest in learning science female students' interest is on the high side compared to male students, and first-year students have a high interest in learning science compared to second-year and third-year students. Science teachers are, therefore encouraged to adapt gender responsive pedagogies in teaching science to influence the interest of students in learning science-related subjects.

In furtherance to the findings, science teachers are challenged to look for and apply best practices in instructional strategies, assessment, and classroom management techniques that whip and sustain the interest of students in learning science in high schools. The Government of the Republic of Ghana through the Ministry of Education should adopt other contemporary policies that sustain the interest of females in learning science, helping to achieve SDG3 in science education. Lastly, as interest in science in relation to gender is an interesting area to study, science educators and researchers should investigate further other factors that combine with gender to positively affect male and female students' interest in learning science in high school.

References

1. Adu-Gyamfi, K. (2013). Lack of interest in school science among non-science students at the senior high school level. *Problems of Education in the 21st Century*, 53, 7-21. https://doi:10.33225/pec/13.53.07
2. Akpınar, E., Yıldız, E., Tatar, N., & Ergin, Ö. (2009). Students' attitudes toward science and technology: An investigation of gender, grade level, and academic achievement. *Procedia-Social and Behavioral Sciences*, *1*(1), 2804-2808. https://doi.org/10.1016/j.sbspro.2009.01.498
3. Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, *84*(3), 261-271. https://psycnet.apa.org/doi/10.1037/0022-0663.84.3.261
4. Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.
5. Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
6. Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.
7. Bandhu, D., Mohan, M. M., Nittala, N. A. P., Jadhav, P., Bhadauria, A., & Saxena, K. K. (2024). Theories of motivation: A comprehensive analysis of human behavior drivers. *Acta Psychologica*, *244*, 104177. https://doi.org/10.1016/j.actpsy.2024.104177
8. Bennett, J., & Lubben, F. (2006). Investigating the effectiveness of a context-based approach to the teaching of science. *Research in Science Education*, *36*(1), 95-113.
9. Bernacki, M. L., Nokes-Malach, T. J., & Aleven, V. (2015). Examining self-efficacy during learning: variability and relations to behavior, performance, and learning. *Metacognition Learning 10*, 99–117. https://doi.org/10.1007/s11409-014-9127-x
10. Bernacki, M., Nokes-Malach, T., Richey, J., & Belenky, D. (2016). Science diaries: A brief writing intervention to improve motivation to learn science. *Educational Psychology*, 36(1), 26-46. https://doi.org/10.1080/01443410.2014.895293
11. Boukayoua, Z., Kaddari, F., & Bennis, N. (2021). Students' interest in science learning and measurement practices. Questions for research in the Moroccan school context. *SHS Web of Conferences* 119. 1-4. https://doi.org/10.1051/shsconf/202111905006
12. Bourdieu, P. (1986). "The Forms of Capital." In J. E. Richardson (Ed.), Handbook of theory and research for the sociology of education, New York: Greenword.
13. Carlone, H. B., & Johnson, A. (2007). Multicultural science education: More than just a good idea. *Cultural Studies of Science Education*, *2*(2), 397-420.
14. Cheung, D. (2017). The key factors affecting students' individual interest in school science lessons. International *Journal of Science Education, 40*(1), 1-23. https://doi.org/10.1080/09500693.2017.1362711
15. Conel, E. B. (2021). Factors affecting students' interest in learning science. *International Journal of Science Education*, *40* (1), 32-54.
16. Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*(1), 19-43. https://doi.org/10.1146/annurev-orgpsych-032516-113108
17. Direito, I., Connolly, J., Simon, S., & Trevethan, J. (2017). *Gender differences in science interest, self-concept, and career aspirations*. European Science Education Research Association (ESERA) conference proceedings, Dublin City University, Dublin. https://discovery.ucl.ac.uk/id/eprint/10053455
18. Djudin, T. (2018). How to cultivate students' interests in physics: A challenge for senior high school teachers. *Jurnal Pendidikan Sains*, *6*(1), 16-22.
19. Drechsel, B., Carstensen, C., & Prenzel, M. (2011). The role of content and context in Pisa interest scales - A study of the embedded Interest Items in the PISA 2006 Science Assessment. *International Journal of Science Education*, 33(01), pp.73-95. 10.1080/09500693.2010.518646ff.ffhal-00658172
20. Ebenezer, J., & Zoller, U. (1993). Grade 10 students' perceptions of and attitudes toward science teaching and school science. *Journal of Research in Science Teaching*, 30(2), 175-186. https://doi.org/10.1002/tea.3660300205
21. Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*, 109-132.
22. Eccles, J. S., & Wigfield, A. (2024). The development, testing, and refinement of Eccles, Wigfield, and colleagues' situated expectancy-value model of achievement performance and choice. *Educational Psychology Review*, *36*(2), 1-29.
23. Eccles, J. S., Adler, T. F., & Futterman, R. (1983). Expectancies, values, and academic behaviours. In J. T. Spence (Ed.), *Achievement and Achievement Motives.* (pp. 75-146). San Francisco: W.H. Freeman.
24. Furtak, E. M., Belgard, J. R., & Sweeney, W. (2012). The Effectiveness of inquiry-based learning on students' science achievement and attitudes: A meta-analysis. *Journal of Research in Science Teaching*, *49*(1), 50-76.
25. Gonzalez, A. M., Magana, A. J., & Heddleston, S. (2015). The impact of computer simulations in physics on student engagement and learning. *Journal of Research in Science Teaching*, *52*(2), 225-245.
26. Glory, G. E., & Ihenko, S. (2017). Influence of gender on interest and academic achievement of students in integrated science in Obio-Akpor local government area of Rivers State. *European Scientific Journal*, *13*(10), 211-219. https://doi.org/10.19044/esj.2017.v13n10p272
27. Harackiewicz, J. M., Durik, A. M., Barron, K. E., Linnenbrink-Garcia, L., & Tauer, J. M. (2008). The role of achievement goals in the development of interest: Reciprocal relations between achievement goals, interest, and performance. *Journal of Educational Psychology*, *100*, 105-122. https://doi:10.1037/0022-0663.100.1.105
28. Hasni, A., & Potvin, P. (2015). Student's interest in science and technology and its relationships with teaching methods, family context, and self-efficacy. *International Journal of Environmental & Science Education*, 10(3), 337-366. https://doi:10.12973/ijese.2015.249a
29. Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41, 111–127. https://doi.org/10.1207/s15326985ep4102_4
30. Hidi, S., & Harackiewicz, J. (2000). Motivating the academically unmotivated: A critical issue for the 21st Century. *Review of Educational Research*, *70*(2), 151-179.

31. House, J. D. (2009). Classroom instructional strategies and science career interest for adolescent students in Korea: Results from the TIMSS 2003 assessment. *Journal of Instructional Psychology*, *36*, 13-19.
32. Jia, C., Yang, T., Qian, Y., & Wu, X. (2020). The gender differences in science achievement, interest, habit, and creativity. *Science Education International 31*(2), 195-202 https://doi.org/10.33828/sei.v31.i2.
33. Jones, M. G., Howe, A., & Rua, M. J. (1999). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *The class of 2001*. 180-192.
34. Krapp, A. (2002). An educational-psychological perspective on interest in modern learning environments. *Learning and Instruction*, *12*(5), 05-169.
35. Kristyasari, M. L., Yamtinah, S., Utomo, S. B., Ashadi, Indriyanti, N. Y. (2018). Gender differences in students' science literacy towards learning on integrated science subject. *Journal of Physics: Conference Series, 1097(), 012002–. https://*doi:10.1088/1742-6596/1097/1/012002
36. Ministry of Education. (2010). *Teaching syllabus for chemistry: Senior high school 1- 3*. Accra: Author.
37. Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—what is it and does it matter? *Journal of Research in Science Teaching*, *47*(4), 474-496.
38. Ng, B., Liu, W. C., & Wang, C. K. (2015). A preliminary examination of teachers' and students' perspectives on autonomy-supportive instructional behaviors. *Qualitative Research in Education*, *4*(2), 192-221.
39. Ng, B. (Ed.). (2024). *Self-determination theory and socioemotional Learning*. Singapore Pte Ltd.
40. Nurhidayat, M., & Handayaningrum, W. (2024). Motivational dynamics in education: Exploring current learning theories. *Journal of Elementary School Education*, 248-253.
41. Ogundola, I. P., Agboola, B. G., & Ogunmilade, O. J. (2020). Gender differences in achievement, interest, and retention of students exposed to fabrication and welding engineering craft practice through cognitive apprenticeship instructional technique in Nigeria. *Educational Research and Reviews*, 15(4), 194-202. https://doi.org/10.5897/ERR2020.3929
42. OECD. (2018). *Education at a glance 2018: OECD indicators*. OECD Publishing. https://doi.org/10.1787/eag-2018-en
43. Pallant, J. (2007). *SPSS survival manual: A step by step guide to data analysis using SPSS for windows*. (3rd ed.). England: McGraw Hill Open University Press.
44. Palmer, D. H. (2009). Student interest generated during an inquiry skills lesson. *Journal of Research in Science Teaching*, *46*(2), 147–165. https://doi.org/10.1002/tea.20263
45. Palmer, D., Dixon, J., & Archer, J. (2017). Using situational interest to enhance individual interest and science-related behaviors. *Research in Science Education*, *47*(4), 731–753. https://doi.org/10.1007/s11165-016-9526-x
46. Piaget, J. (1973). *To Understand is to invent: The future of education*. New York: Basic Books.
47. Renninger, K. A. (2000). Individual interest and its implications for understanding intrinsic motivation. In C. Sansone, & J. M. Harackiewicz (Eds.), *Intrinsic and extrinsic motivation: The search for optimal motivation and performance* (pp. 375-407). New York, NY: Academic.
48. Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press. https://psycnet.apa.org/doi/10.152 1/978.14625/28806
49. Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68-78. https://doi.org/10.1037//0003-066x.55.1.68
50. Sadler, T. D., Coyle, H., & Schwartz, R. (2007). Motivational factors influencing the interest of students in participating in the geo-science degree program. *Journal of Geoscience Education*, *55*(2), 145-157.
51. Steidtmann, L., Kleickmann, T., & Steffensky, M. (2023). Declining interest in science in lower secondary school classes: Quasi-experimental and longitudinal evidence on the role of teaching and teaching quality. *Journal of Research in Science Teaching*, *60*(1), 164-195. https://doi.org/10.1002/tea.21794
52. Toli, G. Kallery, M. (2021). Enhancing student interest to promote learning in science: The case of the concept of energy. *Education Sciences*, *11*(220), 1-15. https://doi.org/10.3390/educsci11050220
53. Trobst, S., Kleickmann, T., Lange-Schubert, K., Rothkopf, A., & Moller, K. (2016). Instruction and students' declining interest in science: An analysis of German fourth-and sixth-grade classrooms. *American Educational Research Journal*, *53*(1), 162-193. https://doi:10.3102/0002831215618662
54. Urhahne, D., & Wijnia, L. (2023). Theories of motivation in education: An integrative framework. *Educational Psychology Review*, *35*, 45. https://doi.org/10.1007/s10648-023-09767-9
55. Vygotsky, L. S. (1978). *Mind in Society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
56. Wong, L. H., Chan, T. W., Chen, W., Looi, C. K., Chen, Z. H., Liao, C. C., ... & Wong, S. L. (2020). IDC theory: Interest and the interest loop. *Research and Practice in Technology Enhanced Learning*, *15*, 1-16. https://doi.org/10.1186/s41039-020-0123-2

Appendix A

Questionnaire on Students' Interest in Science Dear Student,

This is an anonymous questionnaire. Do not write your name, or any other comment that would identify you on the questionnaire. By completing this questionnaire, you are consenting to take part in this study

The questionnaire seeks your opinions and concerns the next generation of Ghanaians towards learning of science in senior high schools.

You are to rank each statement from the LOWER to the HIGHER by ticking in the box under the most appropriate rank. Information from the questionnaire will be used to improve teaching and learning of Science in Ghana.

Thank you for your participation

Tick in the most appropriate box as [√]

A. Demographics

1.	**Sex**	Male [ ]	Female [ ]	
2.	**Age**	10 – 15 years [ ]	16- 20 years [ ]	Above 20 years [ ]
3.	**Class**	SHS 1 [ ]	SHS2 [ ]	SHS3 [ ]
4.	**School-type**	Category A [ ]	Category B [ ]	Category C [ ]

B. I like learning science because

		Arrange from the Lowest to the Highest						
No.	**Statement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5	Learning science in the SHS helps students to related school science to the world outside the school							
6	Learning science at the SHS level is less difficult as the laboratories make use of modern technologies.							
7	Learning science at the SHS level is less difficult as teachers make effective use of the laboratories.							
8	Students spend a lot of time in the laboratory learning through practical work.							
9	The laboratory works in science offer students an opportunity to explore.							
10	Teachers teaching science in our school relate well with students.							
11	Teachers teaching science in our school adapt their teaching strategies to suit their students' learning styles	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12	Teachers teaching science in our school link the concepts they teach to the industry.							
13	If I study science and science-related courses, I will have greater opportunities in the future.							
14	I am pursuing science program because science and technology will help to eradicate poverty and famine in Ghana.							
15	I go to my school counselor for advice on the career to choose relating to my area of science.							
16	I like science and science-related courses because they are beneficial to our Ghana’s economy.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17	I have once met a scientist, and it encouraged me a lot.							
18	In the classroom, our science teachers involve students in the lesson making us the focus of teaching and learning process.							
19	In the classroom, our teachers use participatory strategies to make us search for knowledge on their own in science.							
20	In the classroom, our teachers create a positive learning environment for us to learn science by allowing students to ask questions.							
21	In the classroom, our teachers create a positive learning environment for us to learn science by attending to individual student needs.							

22	In the classroom, our teachers create a positive learning environment for us to learn science by allowing students to consult colleagues.							
23	In the classroom, our teachers create a positive learning environment for us to learn science by smiling towards students even if we are not showing signs of urgency in learning.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
24	In the classroom, our teachers provide feedback on time for us to consolidate our strengths and overcome our weaknesses in science courses.							

25	I feel free to share ideas on scientific concepts publicly during science lessons at the SHS level							
26	As an SHS student, I still want to take a science-related job in the future							
28	I will encourage the young ones to pursue science.							
29	I get good grades in science courses because of my attitude towards science teachers.							
30	I like science and science-related subjects better than most other subjects because the world is all about science and technology.							
31	In pursuing science, I thought I would be a) medical doctor, b. health-service worker, c. engineer, d. scientist, e. computer expert.							
32	I have a renewed attitude towards science and science-related issues because of my experience in science							

33	Learning science at the SHS level eliminates the difficulty associated with science							
34	I am doing well in science because I was involved in a discussion group.							
35	I am doing well in science because I have access to instructional materials such as notes, references, and internet in the school.							
36	I am doing well in science because the examinations are within course outlines	**1**	**2**	**3**	**4**	**5**	**6**	**7**
37	I am doing well in science because teachers ask critical questions that help to understand all that they are teaching under science.							
38	I am doing well in science because teachers tell us what facts or concepts are important to learn for examinations.							
39	I am doing well in science because teachers link new scientific concepts and ideas to previous lessons							
40	I obtain advise on job opportunities on science from parents							
41	My science teachers use their master's works to teach in the classroom to enhance students' learning.							
42	I obtain advise on job opportunities from science professionals							

Appendix B

Factor Loadings from the Rotation

Item		RC1	RC2	RC3	RC4	RC5
q26	As an SHS student, I still want to take a science-related job in the future.	0.811				
q30	I like science and science-related subjects better than most other subjects because the world is all about science and technology.	0.714				
q13	If I study science and science-related courses, I will have greater opportunities in the future.	0.706				
q31	In pursuing science, I thought I would be a) medical doctor, b. health-service worker, c. engineer, d. scientist, e. computer expert.	0.677				
Q28	I will encourage the young ones to pursue science for the future.	0.583				
q14	I am pursuing a science program because science and technology will help to eradicate poverty and famine in our Ghana.	0.544				
q16	I like science and science-related courses because they are beneficial to our Ghana's economy.	0.522				
q21	In the classroom, our teachers create a positive learning environment for us to learn science by attending to individual student needs.		0.735			
q20	In the classroom, our teachers create a positive learning environment for us to learn science by allowing students to ask questions.		0.691			
q18	In the classroom, our science teachers involve students in the lesson making us the focus of the teaching and learning process.		0.675			
q22	In the classroom, our teachers create a positive learning environment for us to learn science by allowing students to consult colleagues.		0.621			
q10	Teachers teaching science in our school relate well with students.		0.616			
Q19	In the classroom, our teachers use participatory strategies to make us search for knowledge on their own in science.		0.588			
q11	Teachers teaching science in our school adapt their teaching strategies to suit their students' learning styles.		0.568			

q12	Teachers teaching science in our school link the concepts they teach to the industry.		0.558					
q24	In the classroom, our teachers provide feedback on time for us to consolidate our strengths and overcome our weaknesses in science courses.		0.507					
q36	I am doing well in science because the examinations are within course outlines.			0.628				
Q29	I get good grades in science courses because of my attitude towards science teachers.			0.620				
q34	I am doing well in science because I was involved in a discussion group.			0.586				
q38	I am doing well in science because teachers tell us what facts or concepts are important to learn for examinations.			0.564				
q35	I am doing well in science because I have access to instructional materials such as notes, references, and internet in the school.			0.539				
q41	My science teachers use their master's works to teach in the classroom to enhance students' learning.			0.517				
q37	I am doing well in science because teachers ask critical questions that help to understand all that they are teaching under science.			0.501				
q8	Students spend a lot of time in the laboratory learning through practical works.				0.818			
q7	Learning science at the SHS level is less difficult as teachers make effective use of the laboratories.				0.813			
q6	Learning science at the SHS level is less difficult as the laboratories make use of modern technologies.				0.654			
q17	I have once met a scientist, and it encouraged me a lot.						0.711	
q15	I go to my school counselor for advice on the career to choose relating to my area of science.						0.687	
q42	I obtain advice on job opportunities from science professionals.						0.568	