UNVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF SCIENCE EDUCATION

IMPROVING THE PERFORMANCE OF GIRLS IN INTEGRATED SCIENCE THROUGH COOPERATIVE LEARNING: AN ACTION RESEARCH APPROACH.

NATHANIEL KOFI TSATSU

JULY 2012

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JULY, 2012

DECLARATION

CANDIDATE'S DECLARATION

I, Nathaniel Kofi Tsatsu, hereby declare that this thesis with the exception of quotations and references contained in published books which have all been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

…….. ……

NATHANIEL KOFI TSATSU DATE

SUPERVISORS' DECLARATION

I hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of dissertations laid down by the University of Education, Winneba.

…… …….

DR. ISHMAEL K. ANDERSON DATE

(SUPERVISOR)

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DEDICATION

This work is dedicated to my children, Jehoshaphat Sefa Tsatsu and Bethel Delali Tsatsu.

May you grow up and become very great.

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ABSTRACT

The objective of this study was to examine the effect of cooperative learning method of instruction in sustaining interest and improving performance of girls in Integrated Science. Thirty eight (38) girls selected from Form 2 General Arts class in St. Margaret Mary Senior High Technical School participated in this study. Tests, Questionnaires and Treatment Verification Checklist were the main instruments used for collecting data. A self-designed baseline survey test, pre-intervention test, was conducted to determine the previous knowledge base of the respondents in some selected topics in Integrated Science. The cooperative learning method was carried out as an intervention to stimulate the interest of the girls in Integrated Science for eight weeks. A post-intervention test was then administered to determine the effect of the intervention in stimulating the interest and improving the performance of the girls in Integrated Science. A t-test showed that, there was a significant difference in the performance of the girls in the post-intervention tests. According to the results of the post- intervention test, questionnaires and the Treatment Verification checklist, Cooperative Learning Approach improved achievement and brought about an enhanced interest of the girls in Integrated Science. It can be concluded that the Cooperative Learning Approach is an innovative pedagogy to change teaching and learning practices in the science classroom. The intervention fostered positive classroom interactions, promoted positive attitudes towards science and provided opportunities for developing critical thinking and analytical skills. The study therefore recommended further research in to the Cooperative Learning Approach in other topics of Science in other School.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter focuses on the background to the study of the low interest and participation of girls in science. It also contains the statement of the problem of low performance of girls in science and the purpose of the study in enhancing and sustaining the interest of females science as well as the research questions used to guide the study. The chapter includes the statement of the hypothesis, significance of the study in solving perennial issues of low participation and representation of girls in science at all levels. The chapter concludes with the limitations that might have affected the collection of data, findings of the study analysis as well as the delimitations of constraints identified during the study.

1.1 Background of the study

One of the clearest signs of intellectual health of society is the strength of its science education (Oakes, 1991). Science has helped to spur developments in research and industrial technology and ultimately lead to more diverse and robust economy (Erinosho, 2008; US Department of Labour, 1999). However in Africa and in some advanced countries where a greater emphasis is placed on science education, there is always a segment of the population that does not benefit from the best science education the community has to offer, for example, female counterparts of the society (Nancy, 1999).

According to Gachukia and Kabira (1991), female education and training in Africa is generally characterized by low performance and achievement levels than those of males especially in the sciences. In order to ensure that females and in particular, girls interest in science is enhanced,

a number of NGOs in education, learning institutions, governments in Africa have taken giant steps in securing equal access for females in science education (UNESCO, 2003).

One of such steps taken in this regard is the Millennium Development Goals set by the United Nations which was signed in September 2000 (UN, 2000). One of its goals is the promotion of gender equity in science, mathematics and technology. However, attempts to improve the performance of girls in sciences in Africa in general and Ghana in particular have not produced the expected results. Such situation has been captured in the reports of chief examiners on the Senior Secondary School Certificate Examinations (SSSCE) and West Africa Senior Secondary School Certificate Examinations (WASSCE) form 1993 to 2010 on the performance of students in Core Science and Integrated Science at the Senior High levels (Chief Examiner's Report, 2008, 2010, 2012). In those reports, it is vividly stated the poor handling of basic scientific concepts especially those that involve calculations, explanations of scientific phenomenon and higher order questions (Chief Examiner's Report, 2010). Some and in particular female students have been identified to have a lower capacity in handling some questions effectively. Such include those involving topics like density, motion, energy, mole concept, chemical reactions, matter, mixture, acids, bases and salts in Integrated Science in the SSSCE and WASSCE. These might be some of the problems that have resulted in the low performance of most students, especially girls in the SSSCE and WASSCE. Although quite a number of the students appear to have relatively little difficulty in solving problems involving Biology and Agriculture based questions.

As a requirement for entry into any of the tertiary institutions in Ghana, one has to obtain at least a credit before gaining admission. (UCC, 2012; UEW, 2012; UG, 2012). As a result, some

students especially girls with passes lower than credit (i.e. D6) are unable to gain admission into tertiary education.

Successive Governments of Ghana (GOG) having identified that education of the girl-child holds the key to the eradication of poverty, wealth creation and prosperity, have championed various degrees of interventions to address the problem of low representation of the female at science. This is evident in the educational reforms of 1996, 1999, 2003 (Anamuah- Mensah & Asabre-Ameyaw, 2007). The basic philosophy of these reforms being equipping the Ghanaian student with the necessary knowledge, skill, attitudes for self actualization, socio-economic development and political transformation of the nation (GOG, 1995). Concerned about the persistent lack of gender equity and equality in the participation and achievement in science, successive Governments of Ghana (GOG) undertook various specific interventions. These include the institution of Science, Technology and Mathematics Education (STME) clinics for girls, the development of Girls Education unit within the Basic Education Division to promote the interest of girls as well as increase the participation of girls in science, technology and mathematics education, by improving the quality of teaching and enhancing better perception of science and mathematics in the Senior High School (GOG, 1995). Eshun (2000) reported that, inspite some of these interventions by governments of Ghana, low interest and poor participation of girls in integrated science at the Senior High levels, still persist.

In Saint Margaret Mary Senior High Technical School, the school graduate three different classes of General Arts students each year. Among the subjects offered by the students, Elective Mathematics and Economics which appear to be mathematical and analytical in nature and require more critical thinking, than the rest of the subjects are mostly reading oriented. There is only one class for the 3rd general Arts option where Elective Mathematics and

Economics are offered as Electives compared to the sixty nine (69) girls in the other two classes which has reading subjects for electives.

In all, there were about four hundred and fifty students (450) offering General Arts programme in St. Margaret Mary Senior High Technical School during the 2011/2012 academic year, comprising 236 girls and 214 boys. The General Arts students constitute about 38% of the entire student population in the school. The population of students offering General Arts in form 2 during the 2011/2012 is one hundred and forty four (172). Table 1 below shows the distribution of students in the General Arts classes in form 2.

Table 1: Distribution of students in General Arts Classes

	Arts 1	Arts 2	Arts 3	Totals
Boys	17	16	15	48
Girls	39	43	42	124
Total	56	59	57	172

The school has recorded abysmally low performances of girls in integrated science as compared to boys for the past eight years in the WASSCE. In the form two, where 144 students offer the programme with three different options of subject combination, 85 (59%) are girls whiles 59 (41%) are boys. Information gathered by the researcher from the past terminal reports (3rd term 2011/12 academic year) showed that 67% girls scored marks below 50% in Integrated Science. Terminal exams for the 2nd and 3rd terms in 2011/12 revealed that between 9-14% of the females scored marks between 60% - 70% in Integrated Science. Less than 30% of girls obtained marks from 50% and above in the 1st and 2nd term of 2011/12 exams whiles

about 42% of their male counterparts obtained 60% and above in the same exams. Review of the annual WASSCE results analysis for the past 3years indicate that the percentage of girls who obtain grades ranging from A1 to C6 in Integrated Science, that is, the acceptable grade for entry into any of the tertiary institutions in Ghana, ranges between 3% and 12%, whiles the male passes ranges form 17% - 38%. The bulk of the passes obtained by the girls in Integrated Science ranges from grades D7 and E8. A pass of grade D7 and E8 may deny the girls access into any of the tertiary institutions in Ghana (UEW, 2012; UCC, 2012; UG, 2012). The above information is depicted in the table 2 below.

Table 2: Enrolment and percentage pass by gender in WASSCE between 2008 to 2011

WASSCE (Year)		Number of General Arts students registered for WASSCE			Distribution of Grades	
		Totals	Males	Females	Males	Female
2008	Totals	94	29 (30%)	65(70%)		
	A1-C6				5(17%)	2(3%)
	D7-E8				18(62%)	28(43%)
	F9				6(21%)	35(54%)
2009	Total	85	27(32%)	58(68%)		
	A1-C6				3(11%)	4(7%)
	D7-E8				20(74%)	35(60%)
	F9				4(15%)	19(33%)
2011	Total	143	36(25%)	107(75%)		
	A1-C6				14(38%)	12(11%)
	D7-E8				15(42%)	74(69%)
	F9				7(20%)	21(20%)

Courtesy WAEC

Data on the pre-test conducted also revealed that most of the girls had difficulties in answering questions of cell, work, matter, energy, machines and ruminant production. This low

performance and interest could result partly from the way the Integrated Science is presented in the class to the students. In recent times, there is a global paradigm shift from teacher centred mode of instruction to student centred, problem solving, inquiry based learning which encourages active learning (Erinosho, 2008; Wood, 1987). This has been proven to be effective, enabling students develop the necessary skills, knowledge and attitudes needed towards the learning of science. There is the need for an evolution in pedagogical practice with time to meet the global shift in science instruction, since the acquisition and retention of knowledge, attitudes, skills capabilities, positive change in behavior is developed through quality teaching (Erinosho, 2008).

In Ghana, two types of teaching methods are generally used for instruction by teachers at the basic and senior high levels. These are the lecture method and the Activity method (Adu, Adobor, & Malenaar, 2004). The lecture technique involves oral presentation of material learned by the teacher leaving the students passive. This traditional technique contributes minimally to conceptual understanding school science (McDermott, 1991; Birke & Foster, 1993). The lecture method being heavily teacher centred, negatively affect the sensing, visual, active, inductive, and sequential learning (Erinosho, 2008). However, the strength in using the lecture method is that it is efficient in passing more information to students quickly. It is useful in introducing a lesson, or providing factual knowledge to students as a group. The activity method on the other hand is learner centred. It involves approaches as questions and answer, demonstration, discussion, guided discovery, games, field trip, role play, project, laboratory work and observation (ADPRIMA, 2009; Hewette, 2003; Gross, 1999; Mills, 1999).

There are the modern methods of teaching, such as cooperative learning techniques. This method allows students to work together and accomplish shared goals. The technique ensures

that students benefit from one another's abilities and knowledge as they interact in small group within a non imposing, non threatening and non competitive environment (Johnson & Johnson, 1998). According to Johnson and Johnson (1998), cooperative learning ensure that student maximize their own and each others learning. The terms group learning and cooperative learning are usually used interchangeably, however, they mean different things (Woolfolk, 2001). Group work implies several students working together and working together does not necessarily involve co-operation. In cooperative learning, students work in mixed ability groups and are rewarded on the basis of the success of the group (Woolfolk, 2001). Since cooperative learning positively affects female students' cognitive and affective domains, girls need to learn science in a non competitive, non threatening and cooperative atmosphere to achieve results (Diamond & Jude, 1994). Other authors have documented that learning of science using cooperative techniques improves students attitudes towards the subject (Johnson & Johnson,1998; Agbosu, 2010; Ackah, 2009). It is in this light that the researcher deemed it appropriate to employ the cooperative learning strategy to determine its effect on the interest and performance of General Arts students in St. Margaret Mary Senior High Technical School towards science learning.

1.2 Statement of the problem

Integrated Science as a subject in senior high school programme is a core subject studied by all students. It is a pre-requisite for entry into any institution of higher learning in Ghana. This implies that, students who perform poorly in the subject are denied the opportunity of entering into any of the tertiary institutions in Ghana. It is a common spectacle seeing large number of students especially girls enrolling at remedial centres with the aim of improving upon their grade to enhance their chances of gaining access into any of the institution of higher learning in

the country. Most often than not, the subject which the students tend to have difficulty in is integrated science. Although girls out number boys in St. Margaret Mary Senior High Technical School, analysis of the WASSCE for 2010/2011 revealed a higher percentage pass among boys than girls.

The chief examiners reports in science for the year 2005 indicated poor performance in integrated science, a greater percentage of this being girls. Apart from a handful of females students who are outstanding and a few others who perform creditably in tests and exams, the rest of the girls put up unusual behaviour towards integrated science which culminate into the consequent abysmal performance in tests and terminal exams. As a result of this, girls performing poorly in the Science are denied the opportunity of gaining admission into the country's tertiary institutions unless they re-sit the subject. Meanwhile, parents pay huge sums of money at remedial centres to get their wards to study and re-write Integrated Science. The low achievement of girls in science in St. Margaret Mary Senior High Technical School has implications because of the critical role the subject play in selection for higher education.

1.3 Purpose of the study

The purpose of this study was to examine the effect of cooperative learning method of instruction in sustaining the interest of girls in integrated science in St. Margaret Mary Senior High Technical School. The research focused on addressing the factors contributing to poor performance and reduced interest of girls in integrated science in the school. In addition, the research sought to address the challenge of students in the topics they have difficulty in dealing with, especially calculation oriented problems and problems that require critical thinking and application of scientific phenomena.

1.4 Research questions

To keep focus on the main purpose of the study, the researcher operated with the following formulated research questions to guide the study:

1. What is the Knowledge level of girls in SHS form two in some selected topics in Integrated Science before the use of Cooperative Learning approach?
2. What is the impact of Cooperative Learning Approach on the girls' performance in some selected topics in Integrated Science?
3. What is the interest and attitudes of the girls in Integrated Science after they have been taught using the Cooperative Learning Approach?

1.5 Significance of the study

The findings of this study could position stakeholders and policy makers in education in Ghana to make informed judgments about teaching methodologies that are more likely to appeal to girls in order to improve on achievements and interest in science. Stakeholders can also identify the contextual variables that may be modified to bring about improvement in curricula and writing of science textbooks. Such a step might increase and sustain interest in the learning of science and science related subjects for different groups of female learners.

Also, the finding could give science teachers an insight into cooperative learning approach which is more student centered and provides students with construction of their own knowledge. The Cooperative Learning Approach, however, requires more efforts in lesson planning, preparation and delivery than teacher-centered method.

1.6 Limitation

Some weak points that might have affected the findings of this research are that some students were truants and so were not in school throughout the period. This affected collection of data as well as the results and the analysis of the study.

1.7 Delimitation

Factors such as administrative, social and environmental may have contributed to the low participation and sustenance of interest in the learning of science by females to higher levels of education. However, this study sought to concentrate on the effects of cooperative learning approach in integrated science only at the senior high level of education.

Due to time and financial constraints, the study which should have covered the entire schools in the Accra Metropolitan Area was limited to only St. Margaret Senior High Technical School in Dansoman.

1.8 Organization of the study

This study is organized in five chapters. Chapter one was on the background to the study. It continues with the statement of the study, purpose of the study and the research questions that guided the study. The significance of the study, limitation and delimitation of the study

Chapter two reviewed other studies that were relevant to the present study. Studies on scientific literacy, classroom climate, gender bias, evidence of gender gap and gender bias in science education were reviewed. Cooperative learning and gender perspectives in cooperative learning formed part of this chapter.

Chapter three discussed the methodology of the study including the research design, population and sampling procedure for the study. Instrumentation used for the study comprising a self designed achievement test was outlined. This chapter concluded with data collection procedure and the method used in analyzing the data collected.

Chapter four was on presentation, analysis and discussion of results emanating from the analysis of the data.

Chapter five which is the final chapter of the study presented the summary of the findings, conclusions and recommendations resulting from the outcome of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter reviewed the ideas of various authors that are relevant to the study. It deals with scientific literacy and it importance in developing analytical skills, in helping to make informed decision and entry into various careers. It also discusses the gender differences in participation and pursuit of science by members of both sexes linked to social-psychological factors and the need to maintain equity and equality in the study of science. It also covers the classroom climate needed to maintain gender equality and equity in the acquisition of scientific knowledge. The chapter tackles collaborative Learning and its effect on helping individuals construct knowledge by interacting in a group resulting in consensus building among knowledgeable peers to increase students' ownership of learning. The chapter concludes with cooperative learning techniques whereby students capitalize on one another's resources and skills to ensure success of a group of students working together.

2.1 Scientific Literacy

Science may be defined as a branch of knowledge that produces explanations of natural events and processes based on experiments and observations (Hayfron-Benjamin, 2008). Integrated science as taught in Ghanaian schools consist of Physics, chemistry, Biology and Agriculture. Science allows students to understand natural events and processes, behavior of materials and objects in the environment (Frietze & Hanusa, 1984; Erinosho, 2008). There are several reasons why science is taught in schools. Some significance of scientific literacy includes the following:

1. The knowledge of science develops in students a wide range of skills and thinking capabilities. These skills which include conducting investigations, providing empirical evidence and making rational judgments are needed to make sense of the environment.
2. Scientific literacy is important for individuals to make informed decisions and rational judgments on issues of public interest such as Health and nutrition, Malaria, HIV/AIDS, environmental degradation etc.(Erinosho, 2008)
3. The knowledge of science provides the foundation which is needed for entry into careers such as Medicine, Nursing, Agriculture, Pharmacy, science teaching, and other fields.

For Science to be useful to the students, therefore, the teacher must adopt pedagogical strategies that will promote the acquisition of scientific skills, diverse reasoning and knowledge application among all students.

2.2 Gender and Science

Records available indicate that females lag behind males regarding their participation in scientific knowledge (Yoloye, 1998). The general trend is for them to move from the sciences towards the arts. In Nigeria, available data indicate that girls formed 32% of arts students, 28% social science students and a mere 17% of the natural sciences in the Senior Secondary Certificate Examinations in 1994-2004 (Erinosho, 2008). There is also poor representation of females at the level of academic staff. In some first world countries in Europe where majority of university graduates are women, the proportion of women in top position in European science is still very low in traditional fields of science (Nancy, 1999).

According to Jacobs and Simpkins (2005), girls are less likely to aspire for career in sciences, technology, engineering and mathematics than boys after primary school. Other authors think that, females are incapable of acquiring the skills to learn science because they are deficient in the analytical and visual-spatial skills that are needed for abstract reasoning in science (Acker & Oatley, 1993). However this argument has been proven untenable and emerging evidence shows that ability is not a determining factor in whether or not females would participate in science. Girls and boys can perform equally well if the instructional context is fair and conducive (Khale, 1996; Campbell, Jolly & Perlman, 2002).

It has been shown that the gender differences in participation and pursuit of science by members of both sexes can be linked to social-psychological factors at the level of individual, the home and school that contribute to different interests and attitudes (Oakes,1991; Khale 1996; Campbell et.al., 2002; Erinosho,1999,1997a, 1997b). Some of the individual factors that are critical indicators of achievement among females include attitudes towards science, skills experience, interests, confidence, social background and mathematics anxiety (Fennema & Leder, 1990; Campbell, et. al.,2002; Erinosho, 1999;). The home and society-related factors include sex-role stereotyping, differentiated upbringing experiences and cultural masculine stereotype of science (Frietze & Hanusa, 1984; Gray, 1981; Sinnes, 1998, Tobin, 1996).

2.3 The Classroom Climate

At the school level a myriad of factors that make science learning environment less welcoming to girls include biased curriculum and texts that depict a positive male stereotype and a negative female stereotype of science where females are excluded from examples and illustrations, males being linked to a wider array of scientific occupations than females

(Erinosho, 1997a). This could be detrimental to girl's interest and persistence in learning science. Also, poorly resourced learning environment makes it difficult for teachers to personalize instructional activities and to provide opportunities for hands on activities which makes girls learn and understand concepts better (Anderson, 2006; Ogunkola, Olatoya & Erinosho, 2004; Ndirandu, Kathuri & Mungai, 2003; Watson, 1998). Also, insensitive teaching methods that involve the use of didactic teaching methods which are mainly talk-chalk makes the classroom environment abstract, more competitive for girls. Generally, girls are found to be more responsive to instructional methods that are context based, activity oriented and those that foster collaboration and cooperation. Another factor which negatively affects the female student is inadequate science assessment techniques that are more often that not attached to recall questions and multiple-choice tests. Whereas males tend to cope with such assessment formats, females prefer essay test and application oriented questions where they can express themselves in a less risk taking manner (Erinosho, 2008; Champagn & Sheerwood, 2004). In addition, biased curriculum and text that portray a positive masculine stereotype of science and a negative feminine stereotype of science. In most text books females are excluded in illustrations, women actions are omitted, more masculine generic nouns and pronouns are used, with females in restricted roles in relation to scientific activity. Males are linked to with a wider array of scientific occupations and equipment than females. Such material provide misleading representation of science in relation to females, which could be detrimental to girls' interest and persistence in learning science depending on the extent to which the images are internalized. In addition, the differential interaction between teacher and pupil have the tendency to engage in practices that create unhealthy instructional environment. These include directing more questions to boys than girls and expecting more positive answers from boys than girls, asking

higher cognitive order questions for boys than girls, giving more encouragement to boys than girls.

2.4 Collaborative Learning

In order to ensure equity in science achievements by both boys and girls, teachers need to understand classroom dynamics by avoiding gestures and attitudes that convey bias. They also need to allow students to do more practicals and hands on activities and adopt student centered active teaching strategies that encourage cooperative learning. Collaborative learning is based on different epistemological assumptions and has its roots in social constructivism (Matthews, 1996). It has been contended that the knowledge that students already constructed is based on previous relevant experiences (Powers, 1999). Knowledge is constructed as people talk together, interact in a group resulting in concensus building among knowledgeable peers (Bruffee,1999; Vygotsky, 1978). Kim and Bonk (2002) argued that, the use of collaborative learning groups has demonstrated to increase students' ownership of learning and improve outcomes for students in general and underserved groups of students in particular. According to Gruber and Weitman (1962), underprepared students may benefit more from student led discussions than better students. In contrast, Mckeachie (1986) argued that, in peer tutoring, students doing the teaching learn more than students receiving tutoring. Randall (1999) warned that, group work places too much burden on stronger students and may also be detrimental to students who benefits more from learning alone.

2.5 Cooperative Learning

Cooperative learning is an educational approach which aims to organize classroom activities into academic and social learning experiences. There is much more to cooperative learning than

merely arranging students into groups, and it has been described as "structuring positive interdependence" (Chiu, 2004) . Students must work in groups to complete tasks collectively toward academic goals. Unlike individual learning, which can be competitive in nature, students learning cooperatively can capitalize on one another's resources and skills asking one another for information, evaluating one another's ideas, monitoring one another's work, etc. (Chiu, 2008). Furthermore, the teacher's role changes from giving information to facilitating students' learning (Chiu, 2004; Potthaust, 1999; Sabina, 2006; Smith, 1992; Slavin, 1990). Everyone succeeds when the group succeeds. Ross and Smyth (1995) describe successful cooperative learning tasks as intellectually demanding, creative, open-ended, and involve higher order thinking tasks (Gilles, 2003). Five essential elements are identified for the successful incorporation of cooperative learning in the classroom. The first and most important element is Positive Interdependence. The second element is individual and group accountability. The third element is face to face interaction. The fourth element is teaching the students the required interpersonal and small group skills. The fifth element is group processing (Johnson, Johnson & Holubec, 1994).

2.6 History of Cooperative learning

Prior to World War II, social theorists such as Allport, Watson, Shaw, and Mead began establishing cooperative learning theory after finding that group work was more effective and efficient in quantity, quality, and overall productivity when compared to working alone (Gilles, & Adrian, 2003). However, May and Doob (1937) found that people who cooperate and work together to achieve shared goals, were more successful in attaining outcomes, than those who strived independently to complete the same goals. Furthermore, they found that independent achievers had a greater likelihood of displaying competitive behaviours. Philosophers and

psychologists in the 1930s and 40's such as John Dewey, Kurt Lewin, and Morton Deutsh also influenced the cooperative learning theory practiced today (Sharan, 2010). Dewey believed it was important that students develop knowledge and social skills that could be used outside of the classroom, and in the democratic society. This theory portrayed students as active recipients of knowledge by discussing information and answers in groups, engaging in the learning process together rather than being passive receivers of information (e.g., teacher talking, students listening). Lewin's contributions to cooperative learning were based on the ideas of establishing relationships between group members in order to successfully carry out and achieve the learning goal. According to Sharan (2010), Deutsh's contribution to cooperative learning was positive social interdependence, the idea that the student is responsible for contributing to group knowledge. Since then, David and Roger Johnson have been actively contributing to the cooperative learning theory. In 1975, they identified that cooperative learning promoted mutual liking, better communication, high acceptance and support, as well as demonstrated an increase in a variety of thinking strategies among individuals in the group. Students who showed to be more competitive lacked in their interaction and trust with others, as well as in their emotional involvement with other students. Some years later, Johnson and Johnson (1994) published the five elements essential for effective group learning, achievement, and higher-order social, personal and cognitive skills such as problem solving, reasoning, decision-making, planning, organizing, and reflecting. The five elements include positive interdependence, individual accountability, face-to-face interaction, social skills, and processing.

2.7 Types of Cooperative Learning

Formal cooperative learning is structured, facilitated, and monitored by the educator over time and is used to achieve group goals in task work such as completing a unit (Johnson & Johnson, 1994). Any course material or assignment can be adapted to this type of learning, and groups can vary from 2-6 people with discussions lasting from a few minutes up to an entire period. Types of formal cooperative learning strategies include the jigsaw technique, assignments that involve group problem solving and decision making, laboratory or experiment assignments, peer review work, for example, editing writing assignments. Having experience and developing skill with this type of learning often facilitates informal and base learning (Siltala, 2010). Jigsaw activities are wonderful because the student assumes the role of the teacher on a given topic and is in charge of teaching the topic to a classmate. The idea is that if students can teach something, they have already learned the material. Informal cooperative learning incorporates group learning with passive teaching by drawing attention to material through small groups throughout the lesson or by discussion at the end of a lesson, and typically involves groups of two, example turn-to-your-partner discussions. These groups are often temporary and can change from lesson to lesson very much unlike formal learning where two students may be lab partners throughout the entire semester contributing to one another's knowledge of science. Discussions typically have four components that include formulating a response to questions asked by the educator, sharing responses to the questions asked with a partner, listening to a partner's responses to the same question, and creating a new well-developed answer. This type of learning enables the student to process, consolidate, and retain more information (Siltala, Suomala, Taatila & Keskinen, 2007; Felder, 2001). In group-based cooperative learning, these peer groups gather together over the long term. This could be over the course of a year, or

several years such as in high school or post-secondary studies, to develop and contribute to one another's knowledge mastery on a topic by regularly discussing material, encouraging one another, and supporting the academic and personal success of group members. Base group learning, that is, a long term study group, is effective for learning complex subject matter over the course or semester and establishes caring, supportive peer relationships, which in turn motivates and strengthens the student's commitment to the group's education while increasing self-esteem and self-worth. Base group approaches also make the students accountable to educating their peer group in the event that a member was absent for a lesson. This is effective both for individual learning, as well as social support.

2.8 Elements to Cooperative learning

There are five basic and essential elements to cooperative learning as discussed by Brown & Parker (2009) and Siltala (2010). Firstly, there should be positive interdependence. The students must fully participate and put forth effort within their group. Also, each group member has a role therefore must believe that they are responsible for their learning and that of their group. Secondly, the must be face-to-face promotive interaction. Members promote each other's success. Students need to explain to one another what they have or are learning and assist one another with understanding and completion of assignments. Thirdly, there should be individual and group accountability. Each student must demonstrate mastery of the content being studied. In addition, each student is accountable for their learning and work. Fourthly there should be development of social skills. Social skills include effective communication, interpersonal and group skills. Other skills gained are leadership, decision-making, trust-building, communication, conflict-management skills. Finally, there should be the development of group processing skill. Each group must assess their effectiveness and decide how it can be

improved. In order for student achievement to improve considerably, two characteristics must be present according to (Brown & Ciuffetelli, 2009).

2.9 Techniques in Cooperative Learning

There are a great number of cooperative learning techniques available. Some cooperative learning techniques utilize student pairing, while others utilize small groups of four or five students. Hundreds of techniques have been created into structures to use in any content area (Schul, 2011). Among the easy to implement structures are Think-Pair-Share, Think-Pair-Write, variations of Round Robin, and the Reciprocal Teaching Technique. A well known cooperative learning technique is the Jigsaw, Jigsaw II and Reverse Jigsaw. The think pair share was originally developed by Frank Lyman in 1981. Think-Pair-Share allows for students to contemplate a posed question or problem silently. The student may write down thoughts or simply just brainstorm in his or her head. When prompted, the student pairs up with a peer and discusses his or her ideas and then listens to the ideas of his or her partner. Following pair dialogue, the teacher solicits responses from the whole group (Schul, 2011). In the jigsaw technique students are members of two groups, home group and expert group. In the heterogeneous home group, students are each assigned a different topic. Once a topic has been identified, students leave the home group and group with the other students with their assigned topic. In the new group, students learn the material together before returning to their home group. Once back in their home group, each student is accountable for teaching his or her assigned topic (Schul, 2011). The Jigsaw II is Robert Slavin's variation of Jigsaw in which members of the home group are assigned the same material, but focus on separate portions of the material. Each member must become an expert on his or her assigned portion and teach the other members of the home group (Schul, 2012). There is also the reverse Jigsaw which differs

from the original Jigsaw during teaching portion of the activity. In the Reverse Jigsaw technique, students in the expert groups teach the whole class rather than return to their home groups to teach the content. This variation was created by Timothy Hedeen (Heeden, 2003). Brown and Paliscar (1982) developed reciprocal teaching. It is a cooperative technique that allows for student pairs to participate in a dialogue about text. Partners take turns reading and asking questions of each other, receiving immediate feedback. Such a model allows for students to use important metacognitive techniques such as clarifying, questioning, predicting, and summarizing. It embraces the idea that students can effectively learn from each other (Schul, 2012). Seifert and Sutton (2009) also reported on the Student-Teams-Achievement Divisions (STAD), where students are placed in small groups or teams. The class in its entirety is presented with a lesson and the students are subsequently tested. Individuals are graded on the team's performance. Although the tests are taken individually, students are encouraged to work together to improve the overall performance of the group.

2.10 Research evidence for Cooperative Learning

Research on cooperative learning demonstrated overwhelmingly positive results and confirmed that cooperative modes are cross-curricular (Brown & Ciuffetelli, 2009). Cooperative learning requires students to engage in group activities that increase learning and adds other important dimensions. The positive outcomes include academic gains, improved race relations and increased personal and social development. Students who fully participate in group activities, exhibit collaborative behaviors, provide constructive feedback, and cooperate with their groups have a higher likelihood of receiving higher test scores and course grades at the end of the semester. Cooperative learning is an active pedagogy that fosters higher academic achievement (Tsay, Mina & Miranda 2010). Cooperative learning has also been found to increase attendance,

time on task, enjoyment of school and classes, motivation, and independence (Tsay & Brady 2010).

2.11 Benefits and applicability of Cooperative Learning

Brown and Ciuffetelli (2009) outlined the benefits and applicability of cooperative learning. The procedure enables students demonstrate academic achievement. It is usually equally effective for all ability levels and effective for all ethnic groups. Student perceptions of one another are enhanced when given the opportunity to work with one another. Cooperative learning increases self-esteem and self-concept. The method ensures ethnic and physically or mentally handicapped barriers are broken down allowing for positive interactions and friendships to occur. Cooperative learning results in increased higher level reasoning, increased generation of new ideas and solutions. Greater transfer of learning between situations (Tsay & Brady, 2010).

2.12 Limitations to Cooperative Learning

Cooperative learning has many limitations that could cause the process to be more complicated than first perceived. Sharan (2010) describes the constant evolution of cooperative learning as a threat. Because cooperative learning is constantly changing, there is a possibility that teachers may become confused and lack complete understanding of the method. The fact that cooperative learning is such a dynamic practice means that it can not be used effectively in many situations. Also teachers can get into the habit of relying on cooperative learning as a way to keep students busy. While cooperative learning will consume time, the most effective application of cooperative learning hinges on an active instructor. Teachers implementing cooperative learning may also be challenged with resistance and hostility from students who

believe that they are being held back by their slower teammates or by students who are less confident and feel that they are being ignored or demeaned by their team (Sharan, 2010). Students often provide feedback in the form of evaluations or reviews on success of the teamwork experienced during cooperative learning experiences. Peer review and evaluations may not reflect true experiences due to perceived competition among peers. Students might feel pressured into submitting inaccurate evaluations due to bullying. To eliminate such concerns, confidential evaluation processes may help to increase evaluation strength (Tsay & Brady, 2010).

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the methodology of the study. It covers the research design used to diagnose the problems and intervention likely to bring improvement. It discusses the population of girls, as well as the sample and sampling procedures used and the justification for such procedures. The chapter also delved into the procedure adopted to determine the baseline knowledge of students performance, termed pre-test activity and students' performance, also called post-test activity as a result of the intervention mechanism employed. The chapter also discusses the Cooperative Learning Approach (CLA) used during the intervention process towards the performance of girls in science. The alpha numeric system used in scoring of test is also discussed in this chapter. Finally, the chapter concludes with the statistical methods used in analyzing the data collected.

3.1 Research Design

The research design adopted in this study was an action research. Action research is used to diagnose problems, carry out activities and may be used to reflect on one's practices to bring about an expected improvement, innovation and understanding of problems under investigation (Cohen, Manion & Morrison, 2007; Amedahe, 2002; Bell, 2004; Best & Kahn 1995). According to Mills (2003), action research is any systematic inquiry conducted by the researcher to gather information about ways that a particular school operates, how to teach and how their students learn. The information is gathered with the aim of gaining insight, developing a reflective practice and improving student outcomes (Cohen & Manion, 1994). In St. Margaret Mary Senior High Technical School, there has been persistent poor performance of

girls in Integrated Science. As a way of improving the performance of these girls, action research was adopted to diagnose the problem and as an intervention to improve on performance.

3.2 Population and Sample

The population for the study comprised all students in St. Margaret Mary Senior High Technical School located in Dansoman in the Greater Accra Region of Ghana. The Dansoman community had about nine (9) senior high schools. Margaret Mary Senior High School is a mixed school. However, the girls were the focus of this study because they appear to perform poorly than the boys. However an intact class was used so that, the classroom will have the natural environment. Integrated Science is one of the core subjects apart form English, Mathematics and Social Studies that students need to pass before gaining admission into any of the tertiary institutions in Ghana.

During the 2013/2014 academic year in St. Margaret Mary Senior High Technical School, each year group had students enrolled in six (6) programmes – General Arts, Business, General Science, Visual Arts, Technical and Home Economics. The entire student population is about one thousand two hundred (1200) consisting of 648 girls and 552 boys. Out of this number, thirty eight (38) girls selected from form two General Arts (2A3) were involved in the study.

3.3 Sampling and Sampling Technique

Purposive sampling technique was adopted to select the sample for this study. In this study, the sampling was based on performance of girls in Integrated Science in each of the programmes. Among all the programmes, it is the General Arts' whose performance in Integrated Science had been the lowest over the years as seen in the WAEC results in Integrated Science in the

School. There are three General Arts classes in Form two (2) namely 2A1, 2A2 and 2A3. The population for the study is the entire students of St. Margaret Mary SHTS. The target population is the General Arts students in Form 2 from which a sample was taken from the Form 2 General Arts 3 (2A3). Thirty eight (38) girls form the 2A3 class were involved in the study. Girls from the General Arts classes in form two were preferred in this study because they have had one year of base tuition at the senior high level and have learnt some basic concepts in Integrated Science. Also they were not examination candidates. The second year group of girls in the General Arts class were used because while students' in the first year were yet to be admitted in to the School, the third year's were seriously preparing for the WASSCE and need not interfere with their regular mode of teaching and learning process. The 2A3 class in particular was chosen because they seem to have a phobia for Mathematics oriented subjects. Whiles students in General Arts 1 and 2 (2A1 and 2A2) offer Elective Mathematics, Economics, the 2A3 class offer reading subjects namely English Literature, Christian Religious Studies(CRS), Music and History.

3.4 Research Instrumentation

In this study, data was collected using observation, achievement test (pre-test and post-test) and questionnaires. Observation is a collection of data mainly by vision as stated by Easterby-Smith, Thorpe and Lowe (1991). It also offers first hand information without relying on the reports of others. It is also relatively inexpensive to run. Observation was used in this study to gather information on the girls' reaction towards the use of Cooperative Learning Approach. A treatment verification checklist on Cooperative Learning Approach designed by Reid, Forrestal and Cook (1989) was adapted (Appendix L). This observation checklist was used by the researcher to observe students' behavior and gauge their interest and attitudes towards the use

of cooperative learning. A designed questionnaire was used to collect data from the students regarding their perception of the study of Integrated Science using the Cooperative Learning Approach. The designed questionnaire for the study was in two forms, pre and post intervention questionnaires. The pre-intervention questionnaire was designed to assess information from the girls regarding their perception towards Integrated Science as a subject before implementing the intervention. This consists of eighteen (18) question items (Appendix M). The post-intervention questionnaire on the other hand was used to assess their perception towards Integrated Science after the intervention. This consists of twenty one (21) question items (Appendix N). The information obtained was used to answer the research question three.

The achievement tests consisted of pre and post intervention tests. The Pre-test was carried out to determine the baseline knowledge of girls the four selected topics in Integrated Science. This was done to identify girls' achievement or performance in those topics. The data obtained from the pre-intervention test was used to answer research question one. It also allowed the researcher to evenly put learners in groups which were heterogeneous for the cooperative intervention chosen for the study. The test items were selected from the past questions of the end of third terms exams in Form 1. The topics from which the pre-test intervention questions were drawn had been taught to the girls previously using traditional methods of teaching when they were in first year. However, they were given two weeks to revise before the tests. There were four pre-tests in all, one each for Chemistry, Physics, Biology and Agriculture, which are components of the Integrated Science subject. Each test item were of 10 multiple choice type and one short essay type test items (Appendices A, B, C and D). The test items were based on topics that were taught in Form 1. The topics were atomic structure in Chemistry; work, energy and machines in Physics. In Biology, the girls were tested on cell whiles in Agriculture Science

they were tested on ruminant production. All the topics from which the questions were drawn are listed in the Senior High School syllabus. The test items tested students understanding of concepts and explanation girls give to scientific phenomena. Both the pre and post tests lasted for twenty five (25) minutes. The test items demanded short answers to ascertain whether or not the students can explain scientific phenomena correctly. The test items were scored over twenty depending on the amount of information provided by the student, for example, some questions demanded only one word answer while others demanded well labeled diagrams. Later the marks obtained in Chemistry, Physics Biology and Agric were pooled together to obtain hundred percent (Appendix I). The post-test was used to assess the level of improvement of students performance as a result of the intervention mechanism employed. There were four post tests in all (Appendices E, F, G and H). The post-test items had the same format as the pre-test. Marking schemes for both the pre-test and post test items are provided in Appendices A, B, C, D and E, F G, H) respectively.

3.5 Scoring of pre and post-intervention tests

The ten multiple choice and the one short essay test items were all together scored over twenty (20), thus ten (10) marks for the multiple choice and ten (10) marks for the theory for both the pre-test and post test items. Students' total scores in the four areas of the Integrated Science were graded using the alpha numeric grading system used by the West African Examination Council as follows:

Table 3 : Table showing the alpha numeric grading system used by WAEC

GRADE	MARK	REMARKS
A1	80-100	Excellent
B2	70-75	Very good
B3	70-74	Good
C4	65-69	Good
C5	60-64	Credit
C6	50-59	Credit
D7	45-49	Pass
E8	40-44	Pass
F9	0-39	Fail

Courtesy WAEC

3.6 Intervention

The main intervention used by the researcher was Cooperative Learning Approach to teach as the class worked in groups to interact among themselves. The students were placed in groups of five. However, measures were taken to ensure that, each group was of mixed ability. The researcher met with all the participants and briefed them on the purpose and significance of the study. The process of administering the research instrument was explained and the consent of the respondent sought verbally according to Cohen *et. al*. (2007).

In St. Margaret Mary Senior High School, four periods are allocated for the teaching of Integrated Science lessons per class in a week. The four periods are divided into two blocks and taught in two. The duration of each period is forty (40) minutes. Although they have been

taught in the first year, a revision of the selected topics in Chemistry, Physics, Biology and Agriculture was carried out with the students to refresh their minds on those topics. A pre-test was then conducted to determine the baseline knowledge of the girls. During the intervention Cooperative Learning intervention was used to teach the selected topics in Chemistry, Physics, Biology and Agric. At the end of the intervention, a post test was conducted. The groups were monitored as they solve problems and interact among themselves. Their performance in the post-test was evaluated. The monitoring was carried out by observing students closely as they work on their assigned task. The researcher whiles checking on the students encouraged and motivated them to cooperate with each other. Problems faced by the groups were addresses.

Each day's learning activities were assigned to members in each group to solve aspects of the given task. The solution to the task from each group was arrived at after members of each group discussed their individual solution before reaching a consensus. Group leaders then presented their findings in turn. The researcher then summarized the major points agreed on by all the members in each of the groups in the class. The intervention was practiced for eight (8) weeks. At the end of eight weeks, the scores obtained by each student in the post-test in the selected topics were summed up expressed as a percentage and graded using alpha numeric classification to form the mark and grade in the subject. This was done for both the pre-test and post test scores.

3.7 The Normalized Gain

The study involved mixed methods, where both quantitative and qualitative data were gathered. Mixed methods approach is more than simply collecting and analyzing either qualitative or quantitative data; it also involves the use of both approaches together so that the overall strength

of a study will be greater than either qualitative or quantitative research (Creswell & Plano-Clark, 2003). To gather the quantitative data, a series of pre-test and post-test were conducted to assess students' performances before and after the intervention, so as to check effective gain in students' performance (Creswell & Plano-Clark, 2003). Researchers have developed a variety of tools to perform the average effectiveness of courses in promoting conceptual understanding. One of such tools, most commonly associated is with the work of Richard Hake called the normalized gain; <g> (Hake, 1998). Since its introduction, the normalized gain has been widely used in assessing students performance in pre- and post-tests (Bao, 2006). The normalized gain is defined as the change in score divided by the maximum possible increase, or the ratio of the percentage post-test score minus percentage pre-test score to 100 minus the percentage pre-test score. The normalized gain is calculated using the following mathematical relations:

$$\langle g \rangle = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Maximum score} - \text{Pretest score}}$$

Or

$$\langle g \rangle = \frac{\%\ \text{Posttest score} - \%\ \text{Pretest score}}{100 - \%\ \text{Pretest score}}$$

The normalized gain could be defined for an individual student or as an average measure for a population. In this study, the average normalized gain for the entire class was calculated to express the effectiveness of the lesson in promoting conceptual understanding. Using this gain score, Hake classified normalized gain into three levels. These are High gain, medium gain and low gain. The values assigned to them are as follow:

High gain; <g> greater than 0.7

Medium gain; <g> between 0.3 and 0.7

Low gain; <g> less than 0.3 (Hake, 1998)

Hake concluded that instructions that are based on traditional lecture approach usually have a low gain of <g> less than 0.3. However, instructions that depend on moderately used interactive engagement approaches usually have a medium gain (between 0.3 and 0.7) and a high gain (<g> greater than 0.7) respectively. Qualitative data were collected by finding out a change in attitudes and interest of the girls in Integrated Science. In gathering the qualitative data, a student observation checklist was developed. The observation checklist was used to record students' behavior during the intervention. This allowed an investigation into the impact of Cooperative Learning Approach on students' performance and attitudes towards the study of Integrated Science.

3.8.1 Validity and Reliability of the Instrument

According to Alhassan (2006) validity is the extent to which an instrument measures what it is supposed to measure and performs as it is designed to perform. He further indicated that the validity of a research instrument is concerned with how well it measures the concepts it is intended to measure. Joppe (2000) explains validity as whether a research instrument truly measures what it is intended to measure or how truthful the research results are. The validity of an instrument can be assessed in a number of ways (Kirk, 1986). The instrument used in this study was peer reviewed by colleague science tutors in St Margaret Mary SHTS who had immensed knowledge in Science pedagogy, measurements and evaluation. The criticisms and suggestions enabled the researcher to restructure some of the test items before they were administered. The supervisor of this research work also scrutinized the research instruments to

ensure content validity.

Reliability according to Joppe (2000) is the extent to which results produced by the instrument are consistent over time and becomes accurate representation of the total population under study. In his view, so long as the results of a study can be reproduced under a similar condition to produce similar outcomes, then the research instrument can be considered as reliable (Joppe, 2000). The consistency at which answered questionnaire or test items or individual scores can remain relatively the same can be determined through the use of test-retest method (Charles, 1995; Kirk & Miller, 1986). This attribute of the instrument is referred to as stability. In dealing with a stable measure, the results should remain similar. A high degree of stability indicates a high degree of reliability, which makes the results repeatable.

3.8.2 Pilot-Testing of Instrument

Pilot testing of an instrument is the means of verifying if the research instrument will work in the 'real world'. This is accomplished by trying it out first on respondents with similar characteristics but will not be part of the real work (Gall & Borg 2007). The purpose is to ensure that the instrument does not contain items which are misleading. According to Gall and Borg (2007), it is important to pilot-test a research instrument before using it in a study. Pilot testing may be carried out using a sample of individuals from which the population from which the respondents are taken. It is in view of this that the researcher carried out a pilot-test of the pre-test, post test items as well as the intervention questionnaires on Form 2 Business students at St. Margaret Mary SHTS. Some areas of the instrument were identified during the pilot-test and corrections made.

3.9 Data Analysis

A combination of statistical methods of presentation such as frequency count, tables, percentage, descriptive statistic of mean and standard deviation were used to analyze the data collected. An independent sample t-test at 0.05 level of significance was used to determine whether there was a significant difference between the Pre-test and Post-test. The same procedure was used to determine any significant change in the girls' attitude towards science and comparison of attitudinal change made.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION

4.0 Overview

This chapter presents the analysis of the data obtained from the respondents. It begins with the demographic description of the participants of the study, the analysis for the pre- and post-tests scores. The gain made as a result of the use of the Cooperative Learning Approach as an intervention to improve the performance of the girls in some selected topics in Integrated Science. It also discusses the perception of the girls before and after use of the intervention. Discussion of the results was done along the three research questions that were formulated for the study.

4.1 Demographic Description of Respondents

Demographic description refers to how people are classified into groups using common characteristics such as gender, age, race or income levels. According to Lee and Schulele (2010) demographic information provides data regarding research participant and it provides information which determines whether the individuals in a particular study are representative sample of the target population for generalization purposes. However, in this study, only age distribution of the respondents was outlined. This was done to determine whether maturity was a likely challenge to their performance since the national average age of SHS students is fifteen (15) years.

4.1.1 Age of Respondents

The students' ages are presented in Table 4:

Table 4 : Age Distribution of Students

Age(Years)	Frequency	Percentage (%)
16	8	21.1
17	17	44.7
18	11	28.9
19	2	5.3
Total	**38**	**100**

From the data presented in Table 4 above, majority of the respondents was between 17 (44.7%) and 18 (28.9%) years. Only 5.3% of them were 19 years of age whiles 21.1% were 16years of age. The Ghana Education Service presents its educational structure in 6:3:3:4 format. This means six (6) years of Primary Education, three (3) years each of Junior and Senior High Education and four (4) years of Tertiary Education (Parliament of Ghana, 2010). With this structure of education a child usually starts schooling in Ghana at an average age of six (6) and students at the Senior High School Form Two (2) should be about 17years. Thus, majority of the students fall within the standard age for their academic level. Therefore, maturity in terms of biological age might not be a challenge to their performance in Integrated Science.

4.2 Analysis of Data

In this section, the data gathered from students' pre-test and post-test scores, Students' Observation Checklist and the Students' Attitude Questionnaire were analyzed in line with the research questions as stated in chapter one in this study. Detailed discussion of results is in the subsequent section.

4.2.1 Analysis of Data with respect to Research Question one

RQ1: What is the knowledge level of girls in some selected topics in Integrated Science before the use of Cooperative Learning Approach?

The knowledge level of the girls in the different lessons before the introduction of the Cooperative Learning Approach is shown in Table 5 below.

Table 5: Frequency distribution of Pre-Test Scores in the Lessons.

	Range of Scores					
Lessons	**0-4**	**5-8**	**9-12**	**13-16**	**17-20**	**Total**
Lesson 1	15	20	3	0	0	38
Lesson 2	13	22	3	0	0	38
Lesson 3	11	19	8	0	0	38
Lesson 4	5	31	2	0	0	38

Table 5 shows that majority of the girls scored between 5 and 8 and 0 and 4 in all the tests after each lesson. None of the students scored above 13 marks (65%) of the total score of 20 marks (100%). Considering the score range of 9 and 12, most of the girls performed better in the Test

3 than in the other tests. Whiles eight (8) girls scored between 9 and 12 in test 3, none of them scored above 12 marks (60%) in all four tests. It is seen that 15, 13 and 11 girls scored between 0 and 4 in tests 1, 2 and 3 respectively, however, five (5) girls scored between 0 and 4 in test 4. Some of the respondents scored zero in all four tests (Appendix I). A maximum score of 12 (60%) was obtained in test 3 (Appendix I). The mean score for all the four tests in the pre-test was 5.6 marks (27.83%) out of 20 marks (Table 8).

4.2.2 Analysis with Respect to Research Question Two

RQ2: What is the impact of Cooperative Learning Approach on girls' performance in some selected topics in Integrated Science?

The Table 6 shows the knowledge levels of the girls after the introduction of the Cooperative Learning Approach.

Table 6: Frequency distribution of Post-Test Scores in the Lessons.

	Range of Scores					
Lessons	**0-4**	**5-8**	**9-12**	**13-16**	**17-20**	**Total**
Lesson 1	2	13	17	6	0	38
Lesson 2	2	8	20	8	0	38
Lesson 3	0	4	17	17	0	38
Lesson 4	2	4	16	15	1	38

The research question two sought to find out if the use of Cooperative Learning Approach had any impact on students' performance in those selected topics in Integrated Science. The Table 6 above reveals that a great number of students scored marks ranging between 9 and 12 and 13

and 16, with one student scoring 17 marks in post-test 4 out of a total of 20 marks. This shows a marked improvement in the girls' performance in the post-test compared to the pre-test (Table 5). Few students scored marks ranging from 0 to 4. The lowest mark in Lesson 3 post-test was 5 marks compared to 0 in the lesson 3 pre-test (Appendices I and J). Students' score obtained during the pre- and post-tests were used to calculate their average normalized gain (g) in the parallel lessons before and after the use of the intervention as seen in Table 7 which depicts students' average scores in the pre and post-tests and Hake's gain (g) values.

Table 7: Hake Gain (g) Values for the Lessons

Lessons	N	Mean Pre-Test(SD)	Mean Post-Test(SD)	Hake Gain(SD)
Lesson 1	38	4.97 (2.52)	8.87 (3.71)	0.26 (0.24)
Lesson 2	38	5.32 (2.29)	9.76 (3.53)	0.30 (0.25)
Lesson 3	38	6.11 (2.66)	11.63 (2.47)	0.39 (0.21)
Lesson 4	38	5.86 (1.75)	11.26 (3.67)	0.38 (0.26)

N(Number of students) **SD**(Standard Deviation)

From Table 6, it is observed that the mean score values during the post-test were higher than that of pre-test scores for all the lessons. The average normalized gain (g) for the first lesson was below Hake's low gain of 0.3, which expresses the lack of effectiveness of the lesson to promote conceptual understanding, according to Hake (1998). However, the second, third and forth lessons recorded an improvement in the mean score values of 0.3, 0.39 and 0.38 respectively. Hake's value of between 0.3 and 0.7 is range that depicts effectiveness of the lesson in promoting conceptual understanding (Hake, 1998).

In order to determine whether the performance of girls was different, the mean scores of the post-test lessons and pre-test lessons were subjected to an independent sample T-test at a p-value of 0.05. A difference in mean score at p-value of 0.05 and below is considered significant.

Table 8 shows the differences between the pre- and post- tests mean score value of the four lessons.

Table 8: Mean Differences between Pre- and Post-Intervention Test Scores obtained the Lessons

		N	Mean	Mean Difference Pre-Post Test	Standard Deviation	Sig.
Pre-Post-1	Pre Test	38	4.97		2.52	
	Post Test	38	8.87	3.90	3.53	0.000
Pre-Post-2	Pre Test	38	5.32		2.29	
	Post Test	38	9.76	4.44	3.53	0.000
Pre-Post-3	Pre Test	38	6.11		2.66	
	Post Test	38	11.63	5.52	2.47	0.000
Pre-Post-4	Pre Test	38	5.86		1.75	
	Post Test	38	11.26	5.40	3.67	0.000

Significant at 0.05; $p < 0.05$

Independent-sample t-Test analysis showed that, the difference in the performance between students' mean pre-test scores and mean post-test scores was statistically significant for all the four lessons ($p = 0.000, 0.000, 0.000$ & 0.000). This signifies that students had a better conceptual understanding in the selected topics in Integrated Science when exposed to

Cooperative Learning Approach than before.

The Table 9 below shows the overall mean difference between pre- and post-intervention test scores of girls in the Lessons.

Table 9: Overall Mean Difference between Pre- and Post-Intervention Test Scores of Girls in the Lessons.

	N	Mean	Mean Difference	Standard Deviation	Sig	Hake Gain (SD)
Pre-test	38	27.83		7.68		
Post-test	38	51.91	24.08	11.11	0.000	0.33 (0.16)

Significant at 0.05; $p < 0.05$

4.2.3 Analysis with Respect to Research Question Three

RQ3: What is the attitude of girls in after they have been taught Integrated Science using Cooperative Learning Approach?

To determine a change in attitude and interest of learners towards Integrated Science, a pupil observation checklist (Appendix L) was used as well as pre and post intervention questionnaires. For the pupil observation checklist, an observation was checked on a scale ranging from one to four. The attitudinal scale on the pupil observational guide were, 4 indicating very good, 3 indicating good, 2 indicating fair and 1 indicating poor in the measurement of the attitudes exhibited. The observation was made twice a week for a total of 8 weeks and the average calculated. The pupil observational guide was used by the researcher to determine the change in attitudes that were likely to occur as a result of the use of Cooperative

Learning Approach on female students in Integrated Science.

Some of the indicators used are; ability to cooperate with one another to solve problem, perseverance, ability to ask and answer questions, ability to predict correctly etc. (Appendix L).

In Table 10 below, the mean score values show that attitude of female students towards Cooperative Learning Approach improved steadily from the first (1st) to the eighth (8th) week.

Table 10: Attitudes of female learners obtained from Treatment Verification checklist.

Week	Mean scores of students
One	2.7
Two	2.9
Three	3.0
Four	3.3
Five	3.3
Six	3.5
Seven	3.7
Eight	3.7
Total Mean Score	**3.3**

The total mean score was 3.3. This implied that the attitudes of female students towards Cooperative Learning Approach was better.

The pre and post intervention questionnaires were completed by the girls before and after the use of the Cooperative Learning Approach respectively. The result is presented in the Table 11 below:

4.2.4 Comparison of Responses to Pre and Post- Intervention Questionnaires.

The Table 11 below depicts the responses of students for the items in the pre-intervention and post-intervention questionnaires.

Table 11: Percentage of Students responses in the Pre and Post-Intervention questionnaires.

	Statement	Pre-intervention questionnaire		Post- intervention questionnaire	
		Agree	Disagree	Agree	Disagree
1	I have always been afraid of science	84	16	21	79
2	Science is important to my career	39	61	90	10
3	Science is very difficult	79	21	29	71
4	Science is interesting	37	63	84	16
5	I can do better in science	39	61	74	26
6	My success in science is hard work	39	61	84	16
7	My science teacher made me lose interest in science	42	58	5	95
8	My Science teacher makes science very difficult	84	16	29	71
9	My science teacher makes science very interesting	26	74	84	16
10	No teacher can help me understand science	39	61	11	89
11	The method used by my teacher in teaching makes me lose interest in science	74	26	16	84
12	I have better science skills	34	66	79	21
13	Science is very interesting and I like it	29	71	87	13
14	I will advise parents to allow their daughters to read science	16	84	89	11
15	Do you know that a weak pass in integrated science can hinder your chances of pursuing higher education?	74	26	95	5

As many as 84% of students agreed that they have always been afraid of science in the pre-intervention questionnaire. However, this value reduced to 21% in the post intervention questionnaire. This means that 79% of the girls disagreed with the statement in the post intervention questionnaire. Thus 63% of the girls were relieved of the fears they had for science after the intervention.

In the pre-intervention questionnaire, 39% of girls identified that science was important to their career as against 61% which disagreed. Interestingly, after the CLA as an intervention, 90% came to the realization that science was important to their career. Significant majority of students (79%) expressed their perception of the difficulty of Science whiles 21% thought other wise. The percentage of girls who agreed with the statement dropped to 29% with 71% disagreeing to the perception of difficulty in the post-intervention questionnaire. Thus eight weeks of intervention helped to change the perception of 48% of the students who held the assertion that, science was difficult.

Whereas a low number of girls (37%) agreed that Science was interesting in the pre-intervention questionnaire, majority of girls (63%) expressed disinterest. In the post intervention questionnaire however, 84% of the girls expressed their interest whiles 16% still showed disinterest. Thus it was evidently clear that perhaps the intervention used helped promote the interest of about 49% of the girl.

Before the intervention, 39% of the girls agreed they could do better in science whiles 61% thought they could not do well in science. In the post intervention questionnaire however, 74% came to realize that they could do better in science whiles 16% of the girls still retained their inability to do better in Science. However 11% of the girls were undecided if the can do well in

science or not. Thus more of the girls after the intervention realized they had the potential to do better in science.

In the post-intervention questionnaire, a large number (84%) of girls realized that their success in Science was by hard work whereas a small percentage (39%) agreed that hard work was needed for their success in Science in the pre-intervention questionnaire. Thus a greater majority of girls came to understand that with a little extra hard work, they can excel in science.

In the pre-intervention questionnaire, 42% of the girls were of the view that their lack of interest in Science was due to their tutors, thus blaming their poor performance on their science teacher, whiles 58% of the girls disagreed. In the post-intervention questionnaire however, whiles 5% of girls agreed that their science teacher made them lose interest in Science 95% disagreed. Thus 95% of the girls affirmed that after the intervention, the interesting nature of the group work stimulated their interest in Science.

A great majority of the girls (84%) blamed the difficulty they had with Science on their teachers whiles 14% disagreed in the pre intervention questionnaire. After the intervention however, 29% of the girls still blamed their teachers for their difficulty in Science whiles 71% thought otherwise. Thus the interactive nature of the intervention helped to change the perception of 55% more girls.

Although 26% of the girls praised their Science teacher for making lessons interesting in the pre-intervention questionnaire 74% disagreed. However, 84% of the girls testified that the Science lessons were more interesting due to the technique employed by the Science teacher whiles 16% of the girls disagreed in the post intervention questionnaire. Thus, science which hitherto majority of girls thought was not interesting because of the teacher, became interesting

after the intervention. Thus the science teacher through the intervention has helped made science more interesting to 59% more girls compared to the pre intervention period

In the post-intervention questionnaire, whereas 11% of girls were of the view that no teacher can help them understand Science 89% of the girls disagreed. Before the intervention however, 39% of the girls thought no teacher can help them understand Science whereas 61% of the girls disagreed. Thus most girls were of the view that the techniques used by the teacher in teaching science is crucial in facilitating their understanding. Thus, the interventional method used enabled students to develop positive attitude toward the subject.

In the pre-intervention questionnaire, majority of the girls (74%) pointed out that the method used by their teacher made them lose interest in Science whiles 26% disagreed. Thus before the intervention, most of the girls claimed the reason for their lack of interest in science was due to the mode of teaching used by the teacher. After the intervention however, whiles 84% of the girls disagreed that the Cooperative Learning Approach used by the teacher made them lose interest in Science, 16% of the girls agreed.

Few girls (34%) realized that they had better Science skills whiles 66% disagreed in the pre intervention questionnaire. However after the intervention, 45% more girls realized they had better potential skills to excel in science. In the post-intervention questionnaire, 21% of girls still disagreed that they had better Science skills.

Whiles 29% of girls thought that science was very interesting and that they liked it, 71% of the girls disagreed in the pre intervention questionnaire. However in the post-intervention questionnaire, 87% of girls affirmed that Science was interesting and they liked it leaving only 13% of girls to disagree. Thus, before the intervention, fewer girls deemed science as very

interesting. After the intervention however, more of the girls regarded science as interesting, and they loved it. Whiles a small minority (16%) of the girls will advise parents to allow their daughters to read Science 84% of the girls will not. After the Cooperative Learning Approach however 73% more of the girls came to agree that they will advise parents to allow their daughters to read Science, with 11% of the girls still disagreeing.

Most of the girls (84%) in the pre-intervention questionnaire stated that the topics they had already treated which they still find difficult include motion, equilibrium states and stability, chemical equations and formulae, mixtures and solutions, the mole concept, chemical bonds. Thus, their difficult areas were the more calculation oriented topic from physics and chemistry. In the post-intervention questionnaire however, 29% of the girls still expressed their fears in the above listed topics which were the calculation and analytically oriented questions from physics and chemistry.

Interestingly, whiles a great majority of the girls (89%) responded that they preferred studying Science using the Cooperative Learning Approach (CLA) in the post intervention questionnaire, 11% of the girls of the girls did not prefer it.

Most of the girls who responded yes in question 20 indicated they obviously enjoyed working in cooperative group because, they were able to provide help and receive assistance from their peers, share ideas in solving scientific problems, crosscheck answers with other girls in other groups and hence understand the topics taught more easily. However, few girls who responded no to the question intimated that they became bored and felt abandoned by the teacher. They also indicated that the method was time consuming. A few stated that in their attempt to explain points to their colleagues, they were held back and as such preferred working independently to working in groups.

Finally, 89% of the girls testified that their interest in Science had increased with the use of the CLA whiles 5% responded in the negative. Thus the intervention has helped to develop the interest of the girls in the study of Integrated Science with relative ease.

4.3 Discussion of Results

The study set out to find out the impact of Cooperative Learning Approach on the performance and interest of girls of SHS Two General Arts in their study of Integrated Science. In the earlier section of this chapter, results were mainly presented and analyzed based on the specific research questions. In this section, however, the results are discussed in detail also along the research questions which guided the study.

Results with respect to question one indicated that there was a relatively low performance during the pre-intervention test indicating a poor knowledge base of the students in the selected topics in Integrated Science. Only two girls (5%) scored between grade 50% and 59% with the majority of girls (95%) scoring very low marks (Appendix I). This may be attributed in part to the mode of instruction which was more teacher centered than student centered. It will be noted that, a revision class in each of the selected topics was carried out by the researcher with the students before the intervention and hence the test. This method was more traditional teaching. According to McDermott (1991) and Birk and Foster (1993), the lecture technique of teaching which is a component of traditional method of teaching, contributes minimally to conceptual understanding of school science. This was further corroborated by Erinosho (2008). Erinosho (2008) indicated that teacher centered techniques of instruction negatively affects the sensing, visual, active, inductive and sequential learning.

Results with respect to research question two indicated that there was an overall gain in students' performance and consequently in conceptual understanding (Table 7).

The performance of the SHS Two General Arts girls was improved after their exposure to Cooperative Learning Approach than before. From Tables 8 and 9, it can be observed that the difference in students' mean score value before and after the intervention was statistically significant with p values of 0.000. The Hake value for the 1st, 2nd, 3rd and 4th lessons were 0.26, 0.30, 0.39 and 0.38 respectively (Table 7). The average normalized gain was 0.33. The normalized gain for the first lesson was below Hake's low gain (g) of 0.3. This gain of 0.26 for the first lesson could be attributed to the students' lack of readiness for the instructional approach of cooperative learning. Observation from the teacher's checklist for the first lesson indicated that the students did not show very active participation in the group in terms of lack preparation for lessons, poor face to face interaction, lack of communication among them, failure to share ideas, failure to solicit help from group members. This led poor performance in the first lesson. After the first lesson when the students' developed in depth knowledge in CLA by good communication, sharing ideas, seeking help from group members etc., the students showed an improved active participation in the subsequent lessons. This resulted in better normalized gain scores for the rest of the lessons (Table 7). This improved performance of the girls as shown in the post- intervention test score could be attributed to the cooperative learning intervention adopted during the intervention. It was noted also that there was an improved interpersonal relationship, communication, face to face interaction, among the students especially those in the same group. These factors might have contributed to the improved performance of the girls. Therefore, it is likely the girls could develop a positive attitude to the learning on Integrated Science. The Cooperative Learning Approach which was used during the

intervention might have contributed to improved performance of the girls indicating the viability of CLA as a method of teaching of Integrated Science to enhance performance. Enhancing performance of students through CLA has also been reported by Slavi and Johnson (1995), Johnson *et. al*. (1998), Acka (2009) and Agbosu (2010). Also, the frequency of group exercises, tests, assignments, project work given to the students after each lesson could have contributed to the improvement of performance of the girls. It was noted that through the intervention, students were seen to be comparing the techniques used in finding solutions to tasks with other students. These processes might have resulted in removing misconceptions about some concepts leading to better understanding of those topics treated with the students. In all, the girls were able to solve difficult problems which hitherto could not, indicating that they have had better understanding of concepts which were discussed in this study. This observation was seen in the way the students participated in exercises, group discussions and assignments given to the group. The involvement of the students in all the activities might have resulted in the higher scores obtained by most of the students in particular girls, in the post-intervention tests as shown in the Appendix J. It might be interpreted that when the girls in general become actively involved in the learning process instead of watching and listening, they are likely to have interest in learning subjects which hitherto they found difficult.

An interesting feature observed about the girls working in group was that they developed an ability to communicate scientific phenomenon among themselves, understood principles and had critical thinking ability. The social environment in which the girls worked and the activities performed by the girls might have motivated them to learn which invariably have contributed to the improvements in their performance. This finding was in line with the finding of a study conducted by Chiu (2008), who used cooperative learning to improve on students' performance.

Since the students worked in mixed ability students in the groups, members gained ideas from members. This is because most of the low ability groups also performed above average. This is shown in the post-intervention scores where three girls scored between 70% and 75% with only five (5) girls scoring below 39% (Appendix J). This supported the idea of Johnson and Slavin (1995) that cooperative learning consistently produce higher scores than in competitive learning condition. It is likely that as the girls discuss problems, they became aware of what they had knowledge of and what they did not, making them to have better understanding of scientific concepts. This perhaps might have alleviated the fear most girls have for science subjects as indicated in the post-intervention questionnaire (Table 11).

Finally, results with respect to research question three indicated that the use of the Cooperative Learning Approach impacted positively on the students' attitudes and interest towards the teaching and learning of Integrated Science. Findings from the analysis of the responds to the questionnaire indicated that at the beginning of the intervention, the students had low interest and negative perception about Integrated Science with a mean score value of 2.7. However after the intervention, their responses showed an interest in CLA as well as the Integrated Science concepts with a mean score value of 3.3 (Table 10). It could be said that the girls became used to the regular pre- and post-intervention tests conducted before and after lessons. The increased teacher-student and student-student interaction and also the active student participation in the interactive lessons might have led to significant improvement in the students' attitudes and interest towards Integrated Science (Table 10). Before the use of the cooperative learning intervention, the girls did not have the mastery of the contents definitions, formulae and facts. This fact corroborated that of Ogunkola et.al (2004), who indicated that competitive learning breeds poor learning attitudes and hence lower performance in science.

Data collected from the girls in pre-intervention and post-intervention questionnaires (Table 11) revealed that most of the students (79%) were relieved of the fears they had for the study of science after the intervention. The girls thus became more interested in their learning of Integrated Science and the misconception that science was a difficult subject was erased from the minds of majority of the girls. A greater percentage (84%) of girls became confident in dealing with scientific problems as indicated in their responds in the post intervention questionnaire. Sharan (2010) also indicated that students in cooperative group are more likely to attribute their success to hard work and ability than to chance. The fact that the girls were relieved of their fears for science is also an evident from the fact that the girls listed few topics (3) as being difficult in the post intervention questionnaire compared to the six (6) topics listed in the pre-intervention questionnaire.

The agreement of a majority of students to the use of cooperative method of learning in studying science is a clear indication that the girls really enjoyed using the procedure. In the light of the above discussion, the cooperative learning strategy put in place by the researcher might have accounted for the improvement in students' performance and attitudes towards Integrated Science. Thus, allowing girls to work together cooperatively is an effective and meaningful pedagogy that enhance their ability to learn science.

4.4 Summary

Data form the various research instruments used for the study was subjected to a thorough analysis for evidence of changes in students' performances, their attitudes and interests. The result obtained from the analysis indicated that there had been significant improvements in the students' performance after they had been exposed to the Cooperative Learning intervention. Also revealed was the positive change in the students' attitudes towards the study of Integrated Science. Hence this study tends to support various findings from researchers such as Agbosu (2010), Acka (2009), Johnson *et. al*.(1998). They all found and reported that there was significant improvement in the performance, attitudinal change and eagerness of students taught with the Cooperative Learning Intervention than those in traditional lessons.

The next chapter of the study which is the final chapter discusses the summary, conclusions drawn and recommendations made from all the four preceding chapters.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter summarizes the findings of a study conducted to improve the performance of girls in Integrated Science through Cooperative Learning. Conclusions and recommendations drawn based on the findings of the study are part of this chapter. Suggestions for further study on improving the performance of girls in Integrated Science are outlined as the final part of this chapter.

5.1 Summary of the Study

The main purpose of this study was to investigate the impact of Cooperative Learning Approach (CLA) on SHS Two (2) General Arts students' performance and interest in the study of Integrated Science in St. Margaret Mary Senior High Technical School in Dansoman, a suburb of Accra.

Action research method was used for this study. The researcher used the Cooperative Learning Approach to teach four selected topics in Integrated Science for eight (8) weeks. The students were assessed before and after each lesson and the scores recorded for pre-intervention test and post- intervention test respectively. A questionnaire was administered to the thirty eight (38) girls involved in the study before the pre-test and before the post-test. An average normalized gain used on the pre- and post- intervention test scores showed a gain of 0.33, which is an indication of the effectiveness of lessons in promoting conceptual understanding, and thus performance since a Hake's gain above 0.3 shows effectiveness of a lesson. An independent

sample t-test measurement with the pre-intervention test and post- intervention test results showed that there was a significant difference in the pre- intervention test and post-intervention test scores with *p* value of 0.000 at a level of significance $\alpha = 0.05$. The study also revealed that students'negative attitudes towards the study of Integrated Science had been replaced with positive attitudes. They were able to exhibit scientific skills in thinking, analysing, and explaining some scientific concepts. Majority of the girls affirmed that learning of science using the cooperative method was effective in promoting understanding. It was thus concluded that the use of Cooperative Learning Approach should be encouraged in teaching Integrated Science at the Senior High School levels in Ghana.

5.2 Summary of Findings of the Study

This section of the study focuses on the summary of the major findings. The first and second research questions deal with the summary of differences in performances of students before and after their exposure to Cooperative Learning Approach. It also continues with the summary of students' normalized gain leading to conceptual understanding in those selected topics in Integrated Science. The final part is about the summary of differences in students' attitudes and interest before and after being exposed to Cooperative Learning Approach. The results of the study are summarized and presented in line with the research questions.

Research Question One:

1.. What is the Knowledge level of girls in some selected topics in Integrated Science before the use of Cooperative Learning approach?

The average score of the students' in the pre-intervention test was very low. None of the students scored above 60% in the selected topics in Integrated Science. A large number of the

students (94%) scored from 0% to 39%. This indicates the girls had a poor conceptual understanding and poor knowledge levels in the selected topics in Integrated Science

Research Question Two

2.. What is the impact of Cooperative Learning Approach on girls' performance in some selected topics in Integrated Science?

The average performance of the students in the post-test was significantly better than the average performance in the pre-intervention tests. The average normalized gain was 0.33 and this is a good gain factor for effectiveness of the Cooperative Learning Approach in promoting conceptual understanding since it is above 0.3 on the Hake's scale. This also shows that the use of Cooperative Learning Approach as an instructional method in the selected topics in Integrated Science led to an improved performance in students' conceptual understanding.

Research Questions Three

3.. What is the interest and attitude of girls in Integrated Science after they have been taught using the Cooperative Learning Approach?

Students' attitudes and interest after exposure to Cooperative Learning Approach improved significantly. Student- teacher and student-student interactions, as well as their interest to learn Integrated Science after they had been exposed to Cooperative Learning Approach also improved. Students sought help from their peers instead of the teacher. The interactive nature of the lessons gave the students the ability to visualize abstract concepts and this might have resulted in effective learning and an appreciation of the lessons taught. The students interaction checklist over the period indicates an improvement in students attitudes and interests. The average attitudinal score was 3.3 out of 4.0. Responses of a post-intervention questionnaire by the students indicate an improvement in the interest of students towards the used of Cooperative

Learning Approach in teaching Integrated Science.

5.3 Conclusions

The findings from the study support the idea that the achievement of girls can be improved using cooperative learning as suggested by Sharan (2010). Erinosho (2008) also added that girls can do better in Integrated Science just as their male counterparts when the right learning climate is provided. It is suggested in this study that the Cooperative Learning Approach developed the students' thinking and problem solving skills and promoted their activeness during teaching and learning process. The intervention might have also increased their confidence in solving problems, thereby producing a higher achievement and better relationships among students. The CLA brought about higher academic achievement than do competitive individual learning experiences.

The above findings not withstanding, the success of effective implementation of CLA depends heavily on the commitment and dedication of teacher implementing it. Without the requisite skills and relevant knowledge, the teacher will find it difficult to use the CLA.

5.4 Recommendations

In the light of the above findings, the following recommendations have been made for teaching Integrated Science, especially lessons involving SHS girls. The recommendations have been grouped into two: (i) recommendations for teachers and schools (ii) recommendation for CRDD, the Ghana Education Service, the Ministry of Education and other stakeholders associated with Science Education.

5.4.1 Recommendations for Teachers and Schools

Science teachers must provide the classroom climate that motivates girls and lesson their anxiety and rather build their confidence in learning Integrated Science.

- Science teachers should use innovative and more effective student-centred strategies by organizing their classes into small heterogeneous groups to work cooperatively to continually enhance performance of students, especially girls in Integrated Science.
- Cultural and social influences that tend to create misconceptions of a negative feminine stereotype of science learning must be reviewed to help empower girls.
- Heads of second cycle institutions should organize seminars and fora to dispel the erroneous misconception that most teachers and parents hold in the learning of Integrated Science that it could only be learnt by boys and that any girls who is good in Science is a witch.
- Heads of Senior High Schools should support teachers who opt to incorporate cooperative learning approaches in their lesson through provision of Teaching Learning Materials.
- Heads of schools must organize in-service training periodically especially for non – professional teachers and teachers who take teaching appointments. In the course of the training, child centered instructional approaches such as cooperative learning should be emphasized.

5.4.2 Recommendations for Stakeholders in Education

- Curriculum planners and developers should introduce Cooperative Learning Approach in the Integrated Science programme. This would encourage science teachers to incorporate interactive activities in their classroom instructions to enhance students'

performance in the subject.

- The Metropolitan Director of Education must organize regular workshops and in-service training sessions for teachers on the theory and practice of the use of cooperative learning approach in the classroom. The facilitators of such workshops should be experts in the field of cooperative learning strategy so as to guide teachers in the use of the approach.
- Other Stakeholders in Science Education in Ghana should request for curriculum modification in Science Education to incorporate innovative and interactive teaching and learning approaches such as cooperative learning approach at the SHS level. This would help in promoting effective understanding of concepts in Integrated Science.

5.5 Suggestions for further research

As a result to the findings obtained and limitations of this study, the following proposals have been made for further research:

1. The study should be replicated in other senior High Schools in Accra Metropolitan area to provide enough information on Cooperative Learning Approach.
2. The sample size was quite small due to the focus of this study. It is therefore recommended that the study be replicated using larger samples to provide a basis for more generalization of the findings of the study about the effectiveness of cooperative learning approach in the teaching and Learning Integrated Science.
3. The study was limited to only four selected topics involving atomic structure, work energy and machines, ruminant production and cell. Thus it is recommended that the study be replicated using cooperative learning approach on other Integrated Science topics such as Amount of Substance, Electricity, Light, Classification, Soil, and

Photosynthesis. Based on these there could be greater generalization of the findings of the study.

5.6 Implications of the Study

This study set out to determine impact of Cooperative Learning Approach (CLA) to teaching Integrated Science on students' performance in the subject and to find out the influence of CLA on students' interest and attitudes in the study of Integrated Science at the Senior High level in Ghana. The CLA had a positive effect on student's performance by improving their conceptual understanding. It also changed their attitudes towards the study of Integrated Science. The following implications could therefore be drawn:

The traditional practice of teacher centred approaches to teaching where the teacher alone decides what goes on and how learning takes place in the classroom has negative effects on students learning. The students tend to be passive and do not take responsibility for their own learning. These observations might have contributed greatly to students' poor performance in Integrated Science and their negative attitudes towards it study in schools. From this study, it is important for the teaching and learning of Integrated Science to be full of innovative and interactive activities. The students should be made to seek clarification and help from their peers, and interact with them than to always rely on teachers for notes.

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APPENDIX A

St. Margaret Mary Senior High Technical School, Dansoman.

Pre test 1

Section A Integrated Science Time: 30minutes

Attempt ***all*** the questions

1. Atomic number is the

A. number of protons B. number of neutrons

C. number of atoms present D. number of electrons and neutrons

2. Isotopes of an element can be distinguished by their relative

A. charges B. masses C. reactions D. valencies

3. Which of the following statements about the atom $^{31}_{15}Y$ is correct?

A. The atom has 31 electron B. the atom has 15 protons

C. the atom has 15 neutrons D. the atomic number is 31

4. The instrument used to determine the number of isotopes in an element is

A. photometer B. mass spectrometer C. Geiger muller counter D. electron meter

5. Protons and neutrons are collectively called

A. nucleons B. Mass number C. Sub-atomic particles D. Atomic number

6. Particles of matter are made of the following except

A. Atoms B. molecules C. moles D. ions

7. The type of bond that exists in carbon (IV) oxide is

A. ionic bond B. covalent bond C. metallic bond D. centre bond

8. The maximum number of electrons that can be accommodated in the third shell of the electronic configuration is

A. 2 B. 12 C. 15 D. 18

9. The electronic configuration of the element with atomic number seven (7) is

A. 2, 3, 2 A. 2, 2, 3 C. 2, 5 D. 5, 2

10. Which of the following is not true about the elements represented by the symbol X and Z.

A. X and Z have the same number of electrons B. X and Z represent atoms of different elements

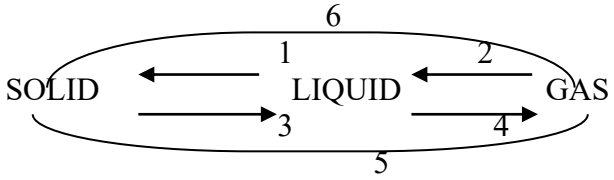
C. X and Z are isotopes D. X and Z represented the same element

Section B

1(a) Tabulate three differences between a proton and an electron

(b) Name the type of bonding present in the following compounds:
Water, Carbon dioxide, sodium chloride, ammonia

(c) The diagram below shows the inter-conversion of one form of matter to another. Study the diagram carefully and answer the questions that follows;



Name the processes in the diagram referred to as 1, 2, 3, 4 , 5, and 6.

MARKING SCHEME

Section A

1. A	2. B	3. B	4. B	5. A	
6. C	7. B	8. D	9. C	10. B	(10marks)

Section B

1(a) Tabulate **three** differences between a proton and an electron

Proton	Electron
It is positively charged	It is negatively charged
It is located in the nucleus	It is located in shells outside the nucleus
It has a mass of 1	It has a negligible mass of 1/1840

(3marks)

(b) Name the type of bonding present in the following compounds:
Water, Carbon dioxide, sodium chloride, ammonia

Compound	Type of bond
Water	Covalent
Carbon dioxide	Covalent
Sodium chloride	Ionic
Ammonia	Covalent

(4 Marks

(c)

1. Freezing
2. Condensation
3. Melting
4. Vapourisation
5. Sublimation
6. Sublimation

(3marks)

APPENDIX B

St. Margaret Mary Senior High Technical School, Dansoman.

Pre-test 2

Section A Integrated Science Time: 30minutes

Attempt ***all*** the questions

1. The S.I unit for power is the
   A. newton B. joule C. watt D. Kelvin

2. A The efficiency of a machine is always less than 100% due to
   A. its high mechanical advantage B. the greater load to effort ratio
   C. the work done when operating D. the work done against friction

3. The derived quantity among the following is
   A. Temperature B. luminous intensity C. work D. amount of substance

4. A device has its pivot between the load and the effort. The type of lever is
   A. first class B. second class C. third class D. none of the above

5. In a certain machine, an effort of 25N was used to overcome a resistance of 100N. During the process, the effort moved through 1m, while the load moved through 0.2m. The Mechanical advantage of the machine is
   A. 25 B. 4 C. 0.25 D. 5

6. In question 5 above, the efficiency of the machine is
   A. 20% B. 80% C. 95% D.100%

7. The energy possessed by a projected stone at its maximum height is
   A. Kinetic energy B. potential energy C. tidal energy D. nuclear energy

8. The ratio of the work output to the work input of a machine is
   A. Mechanical advantage B. velocity ratio C. energy D. efficiency

9. Which of the following statements is not true
   A. Energy is the ability to do work
   B. A boy pushing against a wall does work
   C. The total amount of energy in the universe is constant
   D. The relationship between energy and work is that, energy does work

10. The workdone when a force of 20N moves its point of application through a distance of 5m in the direction of the force
    A. 4J B. 20J C. 100J D. 1000J

SECTION B

1. (a) A girl of mass 65kg climbs a staircase of 50 steps in one minute. The height of each step is 16cm. Assuming that acceleration due to gravity is $10m/s^2$, determine the

(i) Weight of the girl =

(ii) Workdone by the girl =

(iii) Power developed by the girl =

(iv) Potential energy of the girl at the maximum height =

(b) State the law of conservation of energy

MARKING SCHEME

Section A

1. C	2. D	3. C	4. A	5. B	
6. B	7. B	8. D	9. B	10. D	(10 marks)

Section B

(i) Weight of the girl = Mass × Acceleration due to gravity

$= 65kg \times 10m/s^2$

$= 650\ N$ (2marks)

(ii) Workdone by the girl = Force × Distance

$= 650 \times (16/100 \times 50)$

$= 5200J$ (2marks)

(iii) Power developed by the girl $= \frac{\text{Workdone}}{\text{Time taken}}$

$= \frac{5200N}{60s}$

$= 86.66W$ (2marks)

(iv) Potential energy of the girl at the maximum height =Mass × Height × acceleration due to gravity

$= 65kg \times (16/100 \times 50)m \times 10m/s$

$=5200J$ (2marks)

(b) The law of conservation of energy of energy states that, energy can neither be created nor destroyed but is converted from one form to another. (2marks)

APPENDIX C

St. Margaret Mary Senior High Technical School, Dansoman.
Pre-test 3

Section A Integrated Science Time: 30minutes

Attempt ***all*** the questions

1. Bacteria belong to the kingdom
   A. Prokaryotae B. Protoctista C. Fungi D. Plantae

2. Which of the following organisms is ***not*** unicellular?
   A. *Paramecium caudatum* B. *Euglena viridis* C. *Homo sapiens* D. *Amoeba proteus*

3. The akaryote among the following is
   A. Bacteria B. Virus C. Plasmodim D. Green algae

4. Which organelle is referred to as the power house of the cell?
   A. Mitochondria B. Vacuole C. golgi apparatus D. Ribosome

5. The main function of the ribosome is
   A. Transport B Energy production C. protein synthesis D. digestion of food

6. Chromosome are found in the
   A. cytoplasm B.ribosome C. Nucleus D. Mitochondrion

7. The plant cell wall consist mainly of
   A.lignin B. wax C. chitin D. cellulose

8. Which of the specialized cells lack nucleus but contain haemoglobin?
   A. nerve cell B. white blood cell C. sperm cell D. red blood cell

9. Plant absorb water from the soil by
   A. diffusion B. osmosis C. Active transport D. endocytosis

10. The part of a nerve cell that receives a stimulus is the
    A. Dendrite B. Dendrone C. myelin sheath D. axon

SECTION B

(a) Define the following giving **two** suitable examples each
   (i) Tissue (ii) organ
(b) (b) Describe briefly how the sperm cell is adapted to perform its functions.

MARKING SCHEME

Section A

1. A	2. C	3. B	4. A	5. C	
6. C	7. D	8. D	9. B	10. A	(10marks)

Section B

(a) (i) Tissue refers to group of cells of the same size and shape performing the same function.

Examples are muscle tissue, sperm tissue, blood tissue, xylem, phloem, palisade tissue etc.

(4marks)

(ii) Organ refers to different tissues forming a structure to perform a life process.

Examples are eye, nose, ear, liver, kidney, leaf, stem, root, flower etc. (3marks)

(b) Adaptations of the sperm cell to perform its functions.

-The sperm cell has a long tail which wriggles to move it forward

-The middle portion contains numerous mitochondria to provide the energy needed for the wriggling movements

-The head contains the acrosome and nucleus. The acrosome contains digestive juice which dissolves part of the membrane of the egg cell to allow the nucleus of the sperm to enter the ovum.

-The nucleus contain the genetic characteristics of the organism. The nucleus of the sperm fuses with the nucleus of the egg to form a zygote.

(Any 3 × 1) = 3

APPENDIX D

St. Margaret Mary Senior High Technical School, Dansoman.
Pre-test 4

Section A Integrated Science Time: 30minutes

Attempt ***all*** the questions

1. The true stomach of a ruminant is the
   A. Rumen B. Reticulum C. Omasum D. Abomasum

2. Closed castration is carried out using
   A. Cutlass B. burdizzo C. surgical scissors D. thread

3. The ectoparasite among the following is
   A. Tapeworm B. tick C. liverfluke D. roundworm

4. Which of the following is not a ruminant?
   A. Goat B. Cattle C. sheep D. guinea fowl

5. Which of the following is not a sign of a farm animal on heat?
   A. Abnormal high temperature C. Milk yield in lactating cows rise
   B. Loss of appetite D. Ruminant becomes restless

6. The process of giving birth in farm animals is called
   A. Ovulation B. gestation C. parturition D. oestrous

7. Foot and mouth disease is caused by
   A. Bacteria B. Virus C. Protozoa D. Fungi

8. Ectoparasites can be controlled by
   A. Dipping B. Drenching C. vaccination D. Docking

9. The cutting of the tail of ruminants is called
   A. Bloating B. docking C. Dipping D. Drenching

10. Which of the management system of livestock is best suited for dairy cattle
    A. Intensive system C. Extensive system
    B. Semi-intensive system D. Free range

SECTION B

(a) State **two** significance of the following husbandry practices
(i) castration (ii) identification (4marks)

(b) Tabulate **three** differences between hay and silage (3marks)

© Make a well labeled drawing of the complex ruminant stomach. (3marks)

MARKING SCHEME

SECTION A

1. D	2. B	3. B	4. D	5. C	
6. C	7. B	8. A	9. B	10. A	(10marks)

SECTION B

(a)(i) Significance of castration

-It makes the meat tender and tasty

-It makes the animal grow fast and fat

-It makes the animal docile and strong

-It removes offensive smell from farm animals (2marks)

(ii) Significance of Identification

- It reduces livestock theft
- It enables easy recognition of farm animals
- It enhances record keeping
- It aids breeding and management programs (2marks)

(b) Tabulate **three** differences between hay and silage

HAY	SILAGE
It is brown in colour	It is pale green in colour
It has low moisture content	It has high moisture content
It is cut dried fodder	It is cut fodder which has been allowed to ferment
It is less acidic	It is more acidic

(3marks)

© Make a well labeled drawing of the complex ruminant stomach. (3marks)

APPENDIX E

St. Margaret Mary Senior High Technical School, Dansoman.

Post-test 1

Section A Integrated Science Time: 30minutes

Attempt ***all*** the questions

1. Mass number is defined as
   A. Number of protons in an atom
   B. Number of neutrons in an atom
   C. Sum of the number of protons and neutrons in an atom
   D. Sum of the number of electron and protons in an atom

2. Isotopes have
   A. Same atomic number but different proton number
   B. Same neutron numbers but different proton numbers
   C. Same atomic number but different neutron numbers
   D. Same mass number but different prton numbers

3. An atom has 15protons and 15 neutrons. The number of electrons is
   A. 15 B. 30 C. 0 D. 1

4. The charge on the proton is
   A. Negligible B. negative C. neutral D. Positive

5. Neutrons are located in the
   A. Nucleus of an atom B. K-shell C. L- shell D. outside the shells

6. When an atom loses electrons it becomes
   A. Negatively charged B. positively charged C. anion D. excited

7. Ionic bonds are formed by the……. Of electron
   A. Mutual sharing B. unequal sharing C. transfer D. splitting

8. The electronic configuration of the aluminium atom is
   A. 2,8,3 B. 2, 3,8 C. 2,8,2,1 D. 8, 3, 2

9. The general name for the particles found in the nucleus is
   A. Isotope B. nucleon C. protons D. neutrons

10. Which of the following changes directly from the solid to the gas phase at room temperature
    A. Fats B. ice C. wax D. Naphthalene

SECTION B

1(a) Make a well labeled drawing of a lithium atom.

(b) Neon has three isotopes with mass numbers 19, 20 and 21. If the atomic number of neon is 10, determine the number of neutrons in the three isotopes.

© Name the instrument used to determine the number of isotopes in an atom.

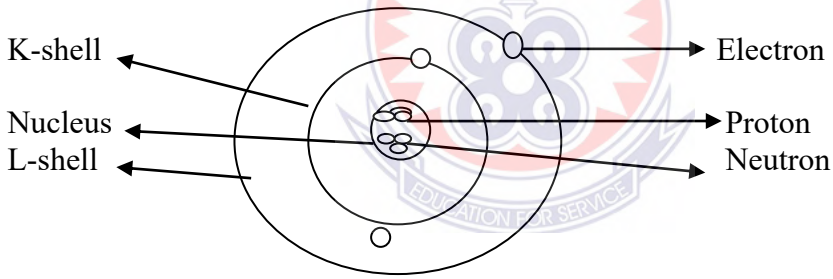
MARKING SCHEME

Section A

1. C	2. C	3. A	4. D	5. A	
6. B	7. C	8. A	9. B	10. D	(10 marks)

Section B

(a) A lithium Atom



4marks

(b) Mass number (A) = Number of proton (Z) + number of neutrons (n)

$^{19}_{10}Ne$	$^{20}_{10}Ne$	$^{21}_{10}Ne$
A = Z+n	A = Z +n	A = Z+n
19 = 10+n	20 = 10+n	21= 10+n
N =19-10=9neutrons	n = 20-10=10neutrons	n= 21-10=11neutrons

4marks

(c) The instrument used to determine the number if isotopes in an atom is the mass spectrometer.

APPENDIX F

St. Margaret Mary Senior High Technical School, Dansoman.

Post-test 2

Section A Integrated Science Time: 30minutes

Attempt ***all*** the questions

1. Which of the following is **not** a fundamental quantity?
A. length B. Density C. electric current D. thermodynamic temperature

2. Friction in car engines can be reduced through
A. lubrication B. overhauling C. spraying D. vulcanizing

3. Which of the following energy sources will never run out?
A. Uranium B. Coal C. petrol D. solar power

4. A certain pulley system have three fixed pulleys and two moveable pulleys. Its Velocity ratio is
A. 2 B. 3 C. 5 D. 6

5. The ultimate source of energy on earth is
A. green plants B. the sun C. fossil fuels D. hydroelectric plant

6. The ratio of the load overcome by a machine to its effort is called
A. velocity ratio B. efficiency C. work input D. mechanical advantage

7. A mango fruit of mass 2000g is suspended 12m vertically above the ground. Determine the potential energy at the maximum height. (take g = $10m/s^2$).
a. 20J B. 1.2J C. 24J D. 240J

8. A device has its effort between the load and the pivot. The type of lever is
A. first class B. second class C. third class D. none of the above

9. Energy is measured in
A. watts B. joules C. metre D. candela

10. The following are all forms of energy except
A. Magnetism B. light C. heat D. chemical.

SECTION B

1. (a) In a certain machine, an effort of 25N is used to overcome a resistance of 100N. During the process, the effort moved through 1m, whiles the load moved through 0.2m. Determine

(i) MA =
(ii) Work output =
(iii) Work input =
(iv) VR =
(v) Efficiency =
(vi) Percentage Energy wasted on friction =

(b) Explain briefly why the efficiency of a machine is always less than 100%

MARKING SCHEME

SECTION A

1. B	2. A	3. D	4. C	5. B
6. D	7. D	8. A	9. B	10. A.

SECTION B

(a) In a certain machine, an effort of 25N is used to overcome a resistance of 100N. During the process, the effort moved through 1m, whiles the load moved through 0.2m. Determine

(i) $MA = \frac{\text{Load}}{\text{Effort}} = \frac{100N}{25N} = 4$ (1 marks)

(ii) $VR = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}} = \frac{1m}{0.2} = 5$ (1marks)

(iii) Work output = Load × Distance moved by load = 100N × 0.2m = 20J (2marks)

(iv) Work input = Effort × Distance *moved by effort* = $25N \times 1m = 25J$ *(2marks)*

(v) $Efficiency = \frac{MA}{VR} \times 100\% = \frac{4}{5} \times 100\% = 80\%$ *(1mark)*

(vI) Percentage energy wasted of friction = 100% - 80% = 20% *(1 marks)*

(b) The efficiency of a machine is always less than 100% because part of the energy input is used to overcome friction, inertia, gravitational force, overcome moving parts of the machine. (2mark

APPENDIX G

St. Margaret Mary Senior High Technical School, Dansoman.

Post-test 3

Section A Integrated Science Time: 30minutes

Attempt ***all*** the questions

1. Which of the following organisms is unicellular?

A. *Homo sapiens* B. Mango C. Mushroom D. Amoeba

2. The correct sequence of organization in a multicellular organism is

A Cell → Organ → Tissue → Organism

B Cell → Tissue → Organ → Organism

C Cell → Organism → Organ → Tissue

D Cell → Tissue → Organism → Organ

Use the organelles below to answer the questions 2 to 4 that follow:

I.Mitochondria II. Chloroplast III. Nucleus IV. Vacuole

3. The organelle which stores genetic information is

A. I B. II C. III D. IV

4. The largest organelle in the plant cell is the

A. I B. II C. III D. IV

5. The organelle responsible for the release of energy is the

A. I B. II C. III D. IV

6. When a plant cell is placed in a hypotonic solution it

A. Swell up and burst B. It becomes turgid

C. It becomes flaccid D. It remains the same

7. Which of the following organisms is eukaryotic?

A. Euglena B. Virus C. Bacterium D. Blue green algae

8. Which of the following components of the cell acts as a partially permeable membrane?

A. Cell wall B. plasma membrane C. Vacuole D. Chloroplast

9. Which of the following is present in all cells?

A. Chloroplast B. Centriole C. cytoplasm D. cell wall

10. Plants absorb mineral salts from the soil by the following processes except

A. Diffusion B. Active transport C. facilitated diffusion D. osmosis

SECTION B

(a) What is a specialized cell? Give **two** suitable examples (3marks)
(b) Name the processes by which the following processes occur:
(i) Absorption of nutrients from small intestines
(ii) Absorption of water from the soil by root hairs (2marks)

(c)(ii) Define organelle. (2marks)

(ii)Name **two** organelles in plant cells and state **one** function of each (3marks)

MARKING SCHEME

SECTION A

1. D 2. B 3. C 4. D 5. A

6. B 7. A 8. B 9. C 10. D

SECTION B

(a) A specialize cell is cell which is structurally modified to perform a particular function Examples include: Palisade cell, Root tip cell, Epidermal cell, erythrocyte, muscle cell, etc. (3marks)

(b)

	Process
(i) Absorption of nutrients from small intestines	Diffusion and active transport
(ii)Absorption of water from the soil by root hairs	Osmosis

(2marks)

(c) (i)An organelle is a living structure in the cytoplasm of a cell bounded by membranes and performs specific functions in the cell. (2marks)

(ii)

Organelle	Function
Vacuole	Stores waste products of metabolism, stores food, controls osmoregulation
Chloroplast	Site for photosyntheis
Nucleus	Controls life activities of the cell, controls heredity, involve in cell division, involved in ribosome synthesis
Ribosome	Site for protein synthesis.

(3marks)

APPENDIX H

St. Margaret Mary Senior High Technical School, Dansoman.
Post Test 4

Section A Integrated Science Time: 30minutes

Attempt ***all*** the questions

1. The largest stomach of a ruminant is
   A. Rumen B. Reticulum C. Omasum D. Abomasum

2. The ruminant among the following is
   A. Rabbit B. cattle C. Domestic fowl D. Pig

3. The endoparasite among the following is
   A. Tick B. Mite C. Tapeworm D. Lice

4. The release of eggs from the ovary is called
   A. ovulation B. implantation C. Gestation D. Parturition

5. Anthrax in farm animals is caused by
   A. Protozoa B. Virus C. Bacteria D. Fungi

6. Endoparasites can be controlled by
   A. Dipping B. Drenching C. vaccination D. Docking

7. The pouring down of liquid drugs down the throat of a farm animal is called
   A. Drenching B.Vaccination C. Identification D. castration

8. Which of the following systems of livestock management will ensure proper record keeping
   A. Free range C. Extensive system
   B. Semi-intensive system D. Intensive system

9. Open castration can be carried out using
   A. Scapel B. burdizzo C. surgical scissors D. thread

10. A male cattle is called a
    A. lamb B.buck C. cow D. bull.

SECTION B

1(a) State **three** signs of oestrous in ruminants. (3marks)

(b) Give **three** differences between body conformation of beef and dairy cattles. (3marks)

© Using a flow chart indicate the path of food through a ruminant stomach. (4marks)

MARKING SCHEME

Section A

1. A.	2. B	3. C	4. A	5. C	
6. B	7. A	8. D	9. A	10. D	(10marks)

Section B

1(a) **Three** signs of oestrous in ruminants.

-The animal becomes aggressive and restless

-The temperature increases abnormally

- The ruminant loses appetite for food

-There is mumus discharged from the vagina

- The vulva swells and become red

(Any 3 ×1= 3marks)

(b) Give **three** differences between body conformation of beef and dairy cattles. (3marks)

Beef cattle	Dairy cattle
They have a blocky/ square shaped body conformation	They have a wedge shaped body conformation
They have short strong and straight limbs	They have long limb
They have a high growth rate	They have a low growth rate
They have small udder	They have large udder
They are generally humped	They are generally not humped

(Any 3 × 1=3marks)

© Using a flow chart indicate the path of food through a ruminant stomach. (4marks)

Rumen ⟶ Reticulum ⟶ Oesophagus ⟶ Mouth ⟶ Oesophagus

Omasum ⟶ Abomasum ⟶ Small Intestine

(Correct sequence + any correct part = 4marks)

APPENDIX I

SCORES OBTAINED BY STUDENTS IN PRE-INTERVENTION TEST

Student ID	CHEMISTRY Pre-Test 1	PHYSICS Pre-Test 2	BIOLOGY Pre-Test 3	AGRIC Pre-Test 4	Total	Pre-test (%)
1	3	5	7	6	21	26.25
2	4	4	8	6	22	27.5
3	4	0	7	5	16	20
4	0	4	0	5	9	11.25
5	6	7	9	4	26	32.5
6	5	6	5	0	16	20
7	5	5	6	5	21	26.25
8	6	5	10	5	26	32.5
9	6	3	6	6	21	26.25
10	7	4	10	7	28	35
11	7	5	7	5	24	30
12	0	7	6	4	17	21.25
13	8	11	12	10	41	51.25
14	9	4	7	7	27	33.75
15	11	8	12	10	41	51.25
16	7	4	9	8	28	35
17	5	7	7	9	28	35
18	6	3	10	4	23	28.75
19	7	4	9	5	25	31.25

APPENDIX I CONT'D

	CHEMISTRY	PHYSICS	BIOLOGY	AGRIC		
Student ID	Pre-Test 1	Pre-Test 2	Pre-Test 3	Pre-Test 4	Total	Pre-Test (%)
20	6	5	5	7	23	28.75
21	4	7	6	5	22	27.5
22	5	5	4	6	20	25
23	6	5	5	7	23	28.75
24	4	6	6	6	22	27.5
25	10	5	7	4	26	32.5
26	0	10	2	6	18	22.5
27	7	11	4	5	27	33.75
28	5	0	4	7	16	20
29	3	6	5	6	20	25
30	4	5	4	7	20	25
31	5	4	5	6	20	25
32	5	4	4	5	18	22.5
33	0	6	3	6	15	18.75
34	3	7	4	5	19	23.75
35	4	5	3	5	17	21.25
36	3	4	4	7	18	22.5
37	4	6	5	6	21	26.25
38	5	5	5	6	21	26.25

APPENDIX J

SCORES OBTAINED BY STUDENTS IN POST-INTERVENTION TEST

Student ID	CHEMISTRY Post-Test 1	PHYSICS Post-Test 2	BIOLOGY Post-Test 3	AGRIC Post-Test 4	Totals	Post-Test (%)
1	10	9	9	8	36	45
2	13	10	12	15	50	62.5
3	9	11	12	10	42	52.5
4	9	7	13	16	45	56.25
5	12	15	14	16	57	71.25
6	11	7	11	12	41	51.25
7	8	9	7	8	32	40
8	13	9	6	9	37	46.25
9	14	15	14	17	60	75
10	12	13	13	13	51	63.75
11	0	11	10	10	31	38.75
12	5	9	12	0	26	32.5
13	14	13	14	11	52	65
14	11	0	12	12	35	43.75
15	10	10	13	14	47	58.75
16	9	0	15	11	35	43.75
17	13	5	10	8	36	45
18	12	13	14	15	54	67.5

APPENDIX J CONT'D

	CHEMISTRY	PHYSICS	BIOLOGY	AGRIC		
Student ID	Post-Test1	Post-Test 2	Post-Test 3	Post Test 4	Totals	Post-Test(%)
19	6	9	9	0	24	30
20	11	10	13	10	44	55
21	0	12	14	13	39	48.75
22	7	14	15	13	49	61.25
23	11	15	14	12	52	65
24	12	9	13	9	43	53.75
25	14	15	14	13	56	70
26	6	11	12	14	43	53.75
27	11	10	13	13	47	58.75
28	10	12	14	13	49	61.25
29	0	8	11	9	28	35
30	5	5	5	15	30	37.5
31	8	14	10	11	43	53.75
32	8	10	10	14	42	52.5
33	9	9	9	15	42	52.5
34	7	9	11	11	38	47.5
35	8	8	8	10	34	42.5
36	6	8	12	11	37	46.25
37	7	8	13	8	36	45
38	6	9	11	9	35	43.75

APPENDIX K

NORMALIZED HAKE GAIN IN ACHIEVEMENT TESTS

Student ID	Test 1	Test 2	Test 3	Test 4	Overall Hake Gain
1	0.41176471	0.266666667	0.15384615	0.142857143	0.254237288
2	0.5625	0.375	0.33333333	0.642857143	0.482758621
3	0.3125	0.55	0.38461538	0.333333333	0.40625
4	0.45	0.1875	0.65	0.733333333	0.507042254
5	0.42857143	0.615384615	0.45454545	0.75	0.574074074
6	0.4	0.071428571	0.4	0.6	0.390625
7	0.2	0.266666667	0.07142857	0.2	0.186440678
8	0.5	0.266666667	-0.4	0.266666667	0.203703704
9	0.57142857	0.705882353	0.57142857	0.785714286	0.661016949
10	0.38461538	0.5625	0.3	0.461538462	0.442307692
11	-0.53846154	0.4	0.23076923	0.333333333	0.125
12	0.25	0.153846154	0.42857143	-0.25	0.142857143
13	0.5	0.222222222	0.25	0.1	0.282051282
14	0.18181818	-0.25	0.38461538	0.384615385	0.150943396
15	-0.11111111	0.166666667	0.125	0.4	0.153846154
16	0.15384615	-0.25	0.54545455	0.25	0.134615385
17	0.53333333	-0.15384615	0.23076923	-0.09090909	0.153846154
18	0.42857143	0.588235294	0.4	0.6875	0.543859649
19	-0.07692308	0.3125	0	-0.33333333	-0.018181818
20	0.35714286	0.333333333	0.53333333	0.230769231	0.368421053
21	-0.25	0.384615385	0.57142857	0.533333333	0.293103448

APPENDIX K CONT'D

NORMALIZED HAKE GAIN IN ACHIEVEMENT TESTS

Student ID	Test 1	Test 2	Test 3	Test 4	Overall Hake Gain
22	0.13333333	0.6	0.6875	0.5	0.483333333
23	0.35714286	0.666666667	0.6	0.384615385	0.50877193
24	0.5	0.214285714	0.5	0.214285714	0.362068966
25	0.4	0.666666667	0.53846154	0.5625	0.555555556
26	0.3	0.1	0.55555556	0.571428571	0.403225806
27	0.30769231	-0.11111111	0.5625	0.533333333	0.377358491
28	0.33333333	0.6	0.625	0.461538462	0.515625
29	-0.17647059	0.142857143	0.4	0.214285714	0.133333333
30	0.0625	0	0.0625	0.615384615	0.166666667
31	0.2	0.625	0.33333333	0.357142857	0.383333333
32	0.2	0.375	0.375	0.6	0.387096774
33	0.45	0.214285714	0.35294118	0.642857143	0.415384615
34	0.23529412	0.153846154	0.4375	0.4	0.31147541
35	0.25	0.2	0.29411765	0.333333333	0.26984127
36	0.17647059	0.25	0.5	0.307692308	0.306451613
37	0.1875	0.142857143	0.53333333	0.142857143	0.254237288
38	0.06666667	0.266666667	0.4	0.214285714	0.237288136
Mean	0.2591944	0.302867384	0.39772727	0.381750466	0.333637192

APPENDIX L

TREATMENT VERIFICATION CHECKLIST FOR SHS STUDENTS LEARNING WITH COOPERATIVE LEARNING METHOD

Attitude by learners in groups	V. Good (4)	Good (3)	Fair (2)	Poor (1)
Individual contribution to task				
Willingness to ask question				
Willingness to answer questions				
Exhibition of procedural skills				
Critical and systematic thinking				
Exhibition of curiosity				
Willingness to share ideas				
Ability to work independently				
Perception towards science				
Perseverance				
Ability to predict correctly				
Ability to critically observe				
Ability to put information together as a whole (synthesis)				
Ability to interpret pictorial information				
Ability to use measuring equipment accurately				

Very good (4) – attitude exhibited by all the groups in the class

Good (3)- attitude exhibited by ¾ and above but not all groups

Fair(2) – attitude exhibited by ½ and above but not ¾ of all the groups

Poor(1)- attitude exhibited by less than ½ of all the groups

APPENDIX M

PRE-INTERVENTION QUESTIONNAIRE

Form: 2A3 SEX: AGE:

Students view on the study of science

	Statement	Agree	Not sure	Disagree
1	I have always been afraid of science			
2	Science is important to my career			
3	Science is very difficult			
4	Science is very interesting			
5	I can do better in science			
6	My success in science is hard work			
7	My science teacher made me lose interest in science			
8	My Science teachers makes science very difficult			
9	My science teachers makes science very interesting			
10	No teacher can help me understand science			
11	The method used by my teacher in teaching makes me lose interest in science			
12	I have better science skills			
13	Science is very interesting and I like it			
14	I will not advise parents to allow their daughters to read science			
15	Do you know that a weak pass in integrated science can hinder your chances of pursuing higher education?			

16. List the topics you have treated in science that you find difficult.

(i)

(ii)

(iii)

17. The method used by my teachers in teaching makes me lose interest in science

Yes…… No…….

18. Do you prefer studying science using the group method?

Yes…… No……

APPENDIX N

POST-INTERVENTION QUESTIONNAIRE

Form: 2A3 SEX: AGE:

Students view on the study of science

	Statement	Agree	Not sure	Disagree
1	I have always been afraid of science			
2	Science is important to my career			
3	Science is very difficult			
4	Science is very interesting			
5	I can do better in science			
6	My success in science is hard work			
7	My science teacher made me lose interest in science			
8	My Science teachers makes science very difficult			
9	My science teachers makes science very interesting			
10	No teacher can help me understand science			
11	The method used by my teacher in teaching makes me lose interest in science			
12	I have better science skills			
13	Science is very interesting and I like it			
14	I will not advise parents to allow their daughters to read science			
15	Do you know that a weak pass in integrated science can hinder your chances of pursuing higher education?			

16. List the topics you have treated in science that you find difficult.

(i)

(ii)

(iii)

18. The method used by my teachers in teaching makes me lose interest in science

Yes…… No……

19. Do you prefer studying science using the group method?

Yes…….. No……

20. If **Yes** or **No** to question 20 above give two reasons.

(i)……

……

……

(ii)……

……

……

21. My interest in science has been increased with the use of the cooperative method.

Yes…….. No……

APPENDIX O

T-TEST ANALYSIS WITH RESPECT TO PRE- AND POST-TEST ANALYSIS

t-Test: Two-Sample Assuming Equal Variances

	Overall Pre-test	*Overall Post-Test*
Mean	27.82894737	51.90789474
Variance	58.92603129	123.541963
Observations	38	38
Pooled Variance	91.23399716	
Hypothesized Mean Difference	0	
df	74	
t Stat	-10.98843761	
P(T<=t) one-tail	1.64606E-17	
t Critical one-tail	1.666570893	
P(T<=t) two-tail	3.29212E-17	
t Critical two-tail	1.992543466	