

UNIVERSITY OF CAPE COAST

USING COOPERATIVE LEARNING MODEL TO ENHANCE ACADEMIC  
PERFORMANCE OF TEACHER TRAINEES IN SOME SELECTED  
TOPICS IN INTEGRATED SCIENCE AT SAINT MONICA'S COLLEGE  
OF EDUCATION

STEPHEN KWAME AMOAKO

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BY

STEPHEN KWAME AMOAKO

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## DECLARATION

### Candidate's Declaration

*I hereby declare that this dissertation is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.*

Candidate's Signature: ..... Date: .....

Name: Stephen Kwame Amoako

### Supervisor's Declaration

*I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.*

Supervisor's Signature: ..... Date: .....

Name: Mr. Richmond Quarcoo-Nelson

## **ABSTRACT**

The study sought to investigate the effects of using cooperative learning on female teacher trainees of the Colleges of Education in learning some selected topics in Integrated Science. The investigation also sought to determine whether the Cooperative Learning Approach enhances the attitude and motivation of the trainees towards learning of Integrated Science.

The study was carried out at the St. Monica's College of Education in the Mampong Municipality of the Ashanti Region. In all, 80 teacher trainees consisting of 40 each from control and experimental groups were purposively sampled to participate in the study. The teacher trainees in the experimental group were exposed to the Cooperative Learning Approach and the trainees in the control group were lectured during the period of the study.

The results of the study showed that the cooperative learning strategy was very relevant and beneficial in helping the teacher trainees of the St. Monica's College of Education to improve on their performance in, and attitudes towards, the teaching and learning of Integrated Science. It was therefore recommended among other things that the science teachers should endeavour to integrate cooperative learning into their routine methods of instruction in the teaching and learning of Integrated Science.

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## **DEDICATION**

To my lovely children, K. O. Amponsah Amoako and Nana Abenaa

Nyamekye Amoako.

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## **CHAPTER ONE**

### **INTRODUCTION**

This chapter discusses some of the areas of the study such as the background to the study, statement of the problem, purpose of the study, and research questions. The rest are the significance of the study, delimitation of the study, limitations of the study, and organisation of the rest of the study.

#### **Background to the Study**

Education is generally considered as the keynote to national development in all societies. It is a lifelong process in which the innate abilities and talents of people, both young and old, are brought out and developed. It is the most potent force shaping peoples' knowledge, attitudes, perceptions, skills, and personalities (Antwi, 1992).

Education may also be recognised as the backbone of every economy. This is because it is concerned with the provision of the required labour force to take up positions in the labour front. Economic crisis and competition in the world market have brought to the fore the need for the application of scientific methods to maximise production. This has also thrown light on the need for research to improve such scientific methods as well as their implementation. The Government of Ghana, seeing the need for science and technology,

deemed it fit to reform the hitherto arts-biased educational system, to include more scientific, technological, and vocational-biased courses. The aim is to raise the needed manpower to lead in the nation's technological advancement.

Singer (1964) noted that it is only where the working force at all levels is sufficiently literate, educated, trained, and mobile to take advantage of new advances in techniques and organisation of production that the creation of a built-in industry of progress becomes possible. It is also recognised that the socio-economic development of any country depends on a cadre of well-educated and well trained personnel produced especially through secondary and tertiary levels of education.

Researchers and writers in recent times have identified the multiple benefits that accrue to females, their families and the nation as a whole as these females delve into the scientific and technological world. Aggrey (1993) indicated that education and training make girls and women more creative, inventive and self-confident. Participants in a conference on Education and Work Opportunities for Females in African Countries in Morocco in May 1971 noted that African women are an indispensable part of the human resource for national development. It was observed that apart from helping to raise the productivity levels of females so as to make them participate more effectively in the economic process, education provides other benefits to females such as making them acquire improved standards of health, nutrition and sanitation (UNESCO, 1986).

Women's unequal access to education thus constitutes a problem which needs to be solved if developing countries like Ghana would achieve any meaningful socio-economic development. This is because if females are to

be able to contribute meaningfully to the socio-economic development of Ghana, then they should be gainfully employed.

Blake (1989) noted that the economic situation of developing countries has compelled their women to engage in low income-generating activities to maintain their families. There is the need for women to acquire skills to raise their income generation capacity to supplement the family budget. In the light of this, most women have to carry out their traditional roles of housekeeping and childcare; and to be gainfully employed, they need to be educated and trained. The Ghanaian society pre-defines women's roles as domestic. They are considered as mothers, wives, house-makers, and gatherers of firewood. With the onset of formal education, professions such as nursing, teaching, secretarial and clerical occupations were considered the preserve of women, while others like engineering, mining, masonry, and carpentry were considered 'no go' areas for women. Such gender stereotypes have kept females from studying the science and technological subjects. But current research shows that women when given the chance in science perform better than their male counterpart. A current research conducted by the University of Cape Coast and Kwame Nkrumah University of Science and Technology indicates that the current best records in physics were set by women.

In a report presented to UNESCO on Access of Girls and Women to Science and Vocational Education, Hallack (1990) remarked that since development in society requires of women, besides family and domestic activities for which training can be given a much wider participation in all types of occupation, the facilities for women and girls in science and vocation should be of the same importance and range as those offered to men. Men and women should have equal opportunity for science education. A special effort

should be made in order to give women the possibility of personal fulfillment in science and vocational education.

However, almost after two decades after which this observation was made and despite the numerous benefits that education and training are known to provide females and the nation as a whole, women's unequal access to and participation in Science Education still remains a national problem. Right from birth, parents perceive and treat their male and female children differently. Boys and girls are given different toys; their rooms are arranged differently and they are made to play different roles in the home. This discriminating treatment of male and female is not different in the educational set up. At the pre-school level, the males are given models of cars, car-tyres, screw drivers, and hammers whilst their females are given models of baby dolls, laddle, coal-pot, saucepan, and apron to play with. At the basic and the senior secondary schools, the teaching staff directly and indirectly encourages the male students to pursue science and technical courses like Physics, Chemistry, Technical Drawing and Metal Work while the female students are made to pursue courses like Home Economics, Catering, and Dressmaking. The teaching industry has very few female teachers handling science subjects. In the Colleges of Education such as St. Monica's College of Education where the trainees are all females, it is interesting to note that only one of the teachers handling science subjects is female who serves as a sole role model to encourage the female trainees to pick up the challenge.

The report of the conference of African States on Education in 1961 urged all African States to accelerate their socio-economic development by placing emphasis on secondary education. In response to this call, UNESCO figures have shown that these African States have had to allocate between 15

and 20% of their total national expenditure, or between 3 and 5% of the gross national product to education (Antwi, 1992).

Lewis (1969) also observed that the best way to develop a country's economy is to turn out more and more youngsters through secondary schools. In Ghana, the first major attempt to link educational policies with manpower development through the secondary schools was initiated by the Nkrumah's administration in the Seven-Year Development Plan (Ghana Seven-Year Development Plan, 1963/64; 1969/70).

Students learn science by listening to their teacher and copying from the chalkboard rather than asking questions for clarifications and justification, discussing and negotiating meanings and conjectures. Consequently students learn science as a body of objective facts rather than a product of human invention. Students learn facts, theorems or formulas instead of probing for meaning and understanding of scientific concepts. That is to say, students hardly ask the logic or philosophy underlying those scientific principles, facts, and formulas.

Few female trainees pursue courses in science and put in their maximum potentials to excel in this subject at St. Monica's College of Education. The notion that science subjects are unfeminine and women who excel in these subjects are unattractive, coupled with the apparent perception of 'low factor of safety' in some courses as well as 'strength requirement', are some of the major factors that undermine the level of attendance and performance of female students. Statistics available for the past few years since the Diploma Certificate was introduced at the Colleges of Education level indicates that the erroneous perception that courses such as Science, Mathematics, and Technology are strenuous activities but which in reality are



not so, highly affect the performance of the female trainees. Besides, trainees' inability to learn in groups but individually could be said to be a contributing factor to their poor performance.

The Government of Ghana and non-governmental organisations are making striding efforts to improve on the perception and the performance of females in science education through workshops, fora and other projects such as Science Technology and Mathematics Education (STME) clinics for girls, access course for women to gain admission into Colleges of Education to pursue science as well as the institution of scholarship schemes for girls, yet the performance of these female trainees in science at St. Monica's College of Education is not encouraging.

From the above, one can understand why over the years Ghana has had to formulate various educational policies and has spent a substantial proportion of her recurrent expenditure on education. Ghana's educational system from the time of independence in 1957 to the mid-1960s was described as one of the best in the whole of Africa (Roemer, 1992).

### **Statement of the Problem**

A series of observations made during Integrated Science lessons taught by some of the science teachers in St. Monica's College of Education revealed that trainees' participation in the lessons were not encouraging. Most trainees provided wrong answers to the questions asked. Besides, the scores recorded from the trainees' exercise books were not impressive. Majority of the trainees scored between 30 and 50% in class exercises and 10 to 50% in end of semester mock examinations. Again the performance of teacher trainees in the end of semester examination as reported in the Chief Examiners report (Institute of Education, 2005; 2006; 2007; 2008; 2009; 2010) indicated that a

large proportion of the trainees performed poorly in Integrated Science of which St. Monica's College of Education, Mampong-Ashanti was no exception.

The Chief Examiner's reports for Integrated Science for the DBE (Diploma in Basic Education) programme, 2007 specifically indicated that 82% was the highest score in Integrated Science and as many as 273 trainees scored below 10%. This unfortunate situation could be due to the fact that the aims/objectives of learning, which the curriculum set to attained, such as improved scientific thinking and understanding and problem-solving skills or experiences of the trainees were not properly enhanced at the implementation stage, which is due to the learning culture of science in schools in Ghana.

In addition, because the lecture method dominates teaching at St. Monica's College of Education, trainees are denied the science that helps them most in solving everyday personal problems. Trainees are also denied relevant science that is most fun and interesting, and many of them think of science as a body of knowledge that is difficult to understand. Many science tutors teach knowledge only and pay little or no attention to the means by which it was discovered. Teachers often teach only a portion of science and neglect the part that helps them most if they are to become functional scientist. Therefore, a study aimed at improving the performance of teaching and learning of Integrated Science of trainees of St. Monica's College of Education through the cooperative method appeared to be warranted.

### **Purpose of the Study**

The study was intended to find out whether cooperative learning can improve trainee teachers' performance in selected topics (photosynthesis, digestion, reproduction, IUPAC nomenclature, balancing of chemical

equations, chemical bonding, mole concept, and measurement) in Integrated Science. It also sought to find out whether cooperative learning has an effect on trainee teachers' content knowledge in Integrated Science and can motivate and improve the trainee teachers' performance in Integrated Science. The study was also aimed at assessing the impact of the cooperative learning; evaluate the outcome of the intervention as a whole and to make recommendations to the appropriate authorities based on the findings of the study.

### **Research Questions**

The following research questions were formulated to guide the study:

1. Is there significant difference between the mean scores of the teacher trainees of St. Monica's College of Education taught Integrated Science using Cooperative Learning Approach and the teacher trainees taught using the lecture method?
2. To what extent does cooperative learning approach enhance the attitude and motivation of teacher trainees of St. Monica's College of Education towards Integrated Science?

### **Significance of the Study**

The study examined the effectiveness of using practical activities such as small group discussion, peer tutoring, demonstration and experimentation in learning concept in Integrated Science. In view of this, it was hoped that the findings from the study would help to address trainees' problems of scoring very low marks in Integrated Science.

It was anticipated that the research findings would be useful to NGOs and organisers of STME clinics who have taken upon themselves to encourage girls and women to pursue Science and Technology Education. The

suggestions and recommendations would be made available to tutors in the Science Department of St. Monica's College of Education, Mampong-Ashanti and could serve as an in-service training manual for classroom teachers as it would enhance their knowledge, skills, and experiences in using cooperative learning to guide trainees in learning. This could help the tutors to improve upon their teaching methods and advocate for up-to-date science equipment for the laboratories.

It was also hoped that the research findings could help the school administration to monitor the performance of science teachers in the school. The study could also be of relevance to the Curriculum Research and Development Division (CRDD), Teacher Education Division (TED), and Institute of Education, University of Cape Coast, who are responsible for developing the curricula for Colleges of Education in the country. Lastly, the findings of the study could also be of some benefit to other researchers who would conduct further studies into the same topic or related ones.

### **Delimitation of the Study**

Many topics are studied in Integrated Science at the Colleges of Education. However, the study was limited to photosynthesis, digestion, reproduction, IUPAC nomenclature, balancing of chemical equations, chemical bonding, mole concept, and measurement.

A study of this nature could have been done for all female Colleges of Education in Ghana, but due to limited financial resources and time, this was not possible. It was, however, confined to St. Monica's College of Education. The study strictly aimed at improving the academic performance of trainees of St. Monica's College of Education in Integrated Science through Cooperative Learning Approach (CLA).

St. Monica's College of Education was selected for the study because of the trainees' low performance in Integrated Science, their accessibility, proximity, and reliability. Findings of the study could not be extended beyond the boundaries of the study. However, other colleges with similar characteristics may adopt these findings to improve academic performance in Integrated Science.

There were 600 trainees at the St. Monica's College of Education. However, only 13.3% of the trainees participated in the study. This is because the study was limited to only two classes of 40 trainees each of the first year group.

### **Limitations of the Study**

According to Best and Kahn (1989) limitations are conditions beyond the control of the researcher that could place restrictions on the conclusion of the study and its application. Time and financial constraints posed serious problems for the work. The times allocated for science on the colleges time table was not enough to favour the intention and expectations of the study. Simultaneously, some trainees' misconception that after all it is the formulae that matter to pass an examination but not the laborious investigations into how the formulae were obtained affected the maximum cooperation needed from them to make the study more successful. All these limitations were controlled to a fair extent by putting in advance measures such as using free periods or library periods on the time table intensively for the study and debunking the trainees' misconception through motivations and making the lessons more attractive to trainees.

Some of the questionnaires were not retrieved from the trainees. This is because 21.3% of the trainees could not respond to the questionnaire on time

and therefore failed to return them. This reduced the number of trainees who responded to the questionnaire, which affected the original plan for the study and limited the generalisation of the findings to cover all the trainees involved in the study.

### **Organisation of the Rest of the Study**

This study is made up of five chapters. There are other four chapters in the study which have been organised to give further meaning to the issues raised in Chapter One.

Chapter Two is review of related literature, which dealt with research ideas about the topic. The areas to be considered are Cooperative Learning Approach, Cooperative Learning Approach and students' performance, and Cooperative Learning Approach and students' attitudes.

Chapter Three is the methodology guiding the study. The areas under Chapter Three includes research design, population and sample, research instrument used, procedure and analysis of the data collected. This also covers pre-intervention, intervention, post intervention, and data analysis plan.

Chapter Four involves results, findings and discussion of findings. The discussion was done with respect to the research questions. The last chapter, which is Chapter Five, deals with the summary, conclusions and recommendations of the study.

## **CHAPTER TWO**

### **REVIEW OF RELATED LITERATURE**

This chapter provides the theoretical perspective and the empirical bases for the study. This has been organised into: Cooperative Learning Approach, Cooperative Learning Approach and students' performance, and Cooperative Learning Approach and students' attitudes.

#### **Cooperative Learning Approach**

Observations made the St. Monica's College of Education have shown that lessons are mostly delivered through the lecture method by the teachers. The lecture method of teaching refers to a teaching approach in which the instructor presents to the learners the information needed to achieve the learning objectives. This method to some extent is teacher-centered and treats learners as passive recipient. Under the lecture method the teacher presents information to his learners by means of teacher-led discussions. The consequence is that students find no need to search for information on their own to facilitate learning and improve performance.

An achiever science teacher knows that students acquire knowledge most easily when the new information bears some relationship to existing knowledge and it is not totally unfamiliar. What is taught might not be meaningful to learners unless it can be related to what is already familiar

Integrated Science at the College of Education level should be interesting to the student. Unless the student's interest is kindled, it would be pointless teaching him or her topics in Integrated Science.

It is understood that students are by nature curious and eventually build upon their own repertoire of concepts in science when given opportunities to interact freely with interesting and challenging tasks in science. Science teaching at the Colleges of Education level should therefore be activity based and hands-on experience. The teacher's role should be one of the facilitator of learning. The teacher by implication should have insight into the task to be performed and probe the student's thinking while the student engages herself in the task. Teachers should guide students in the process of formulating ideas through questioning, suggestions and challenges that will eventually lead students to draw meaningful conclusions. It is based on these facts that currently, research in science education is dominated by two approaches: finding tools to support student-centered classrooms and finding means to overcome conceptual change.

One of the major concept influencing the present day teaching and learning of science and technology is the theory of selection of learning proposed by Hull and Spencer (as cited by Bilodean, 1966). According to Bilodean (1966), Hull and Spencer said that complex learning can be achieved by building the foundation of simple principles. This implies that when the person discovers the basic principles in learning situations, he or she can translate it into complex situations. Therefore, acquisition of basic knowledge by the learner through selection of basic learning principles involving experiments will enable the learner to discover and build complex principles.



Vygotsky (1978) stated that learning awakens in children a variety of internal developmental processes that can operate only when they interact with more competent people in their environment and in cooperation with their peers. He stressed that children develop in a social matrix that is formed by their relationships and interactions with other children. The social environment is a major contributor to the cognition of children because of the open area of communication that exists and allows them to express and negotiate ideas as well as contribute to each other's understanding (Vygotsky, 1978). From the researcher's observations, two particular challenges need to be addressed mutually to improve the quality of teaching and learning of Integrated Science in the Colleges of Education. One paramount issue that comes to the fore concerning alternative learning approaches to the traditional approach (competitive learning) is cooperative learning (an activity method approach). The challenge in education today is to effectively teach students of diverse ability and differing rates of learning. Teachers are expected to teach in a way that enables students to learn Integrated Science and Integrate Science concepts while acquiring process skills, positive attitudes and values, and problem-solving skills. A variety of teaching strategies have been advocated for use in Integrated Science and Integrated Science classrooms moving away from the teacher-centered approach to more students-centered ones. In the last decade, there has been a vast amount of research on cooperative learning in Integrated Science.

Cooperative Learning (CL) is a topic frequently mentioned in conversations about improving education, regardless of the discipline or level of instruction. Some recent definitions of CL include; an activity involving a small group of learners who work together as a team to solve a problem,

complete a task, or accomplish a common goal (Artzt & Newman, 1990). CL is the instructional use of small groups so that students work together to maximize their own and each other's learning (Johnson & Smith, 1991). CL is a task for group discussion and resolution (if possible), requiring face-to-face interaction, an atmosphere of cooperative and mutual helpfulness, and individual accountability. CL falls into the more general category of 'collaborative learning' which is described as working in groups of two or more, mutually searching for understanding, solution, meaning, or creating a product (Goodshell, Maheer, & Tinito, 1992). Davidson and Kroll (1991) defined CL as a kind of learning situation in which students are expected to work as a team collaboratively in a relatively small group while they share ideas and experiences in the processes.

All these definitions of CL aim at one goal, that is, it is a learning in which the goals of different persons are to link that they share a common end-objectives. They learn together and share ideas and opportunities which are essential in achieving their learning task. As the students work together, they seek each other's assistance and help, and also arrive at joint decisions. The achievement of a goal by an individual also means the achievement of success by others in the groups. In other words, success in the attainment of learning goals of an individual will automatically increase the chances of success of other group members. CL takes many forms and definitions, but most cooperative approaches involve small heterogeneous teams, usually of four to five members, working together towards a group task in which each member is individually accountable for part of an outcome that cannot be completed unless the members work together. In other words, the group members are positively interdependent. Positive interdependence is critical to the success of

the cooperative group, because the dynamic of interconnectedness helps students learn to give and take, to realise that in the group, as well as in much of life, each of us can do something but none of us can do everything. When cooperation is successful, synergy is released, and the whole becomes greater than the sum of its parts. For cooperative groups to be effective, members should engage in team building activities and other tasks that deal explicitly with the development of social skills needed for effective teamwork. Members should also engage in group processing activities in which they discuss the interpersonal skills that influence their effectiveness in working together. When full CL structures are implemented, the benefit in student achievement often can be astounding Williams (2007).

The traditional lecture is the predominant means through which principles of Economics classes are taught. Despite the popularity of lecture, alternative teaching pedagogies that employ active learning have received increasing attention in Economics Education in recent years. In contrast to passive learning pedagogies such as lecture, active learning requires the student to be actively engaged in the learning process. 'Active learning' is fairly broad concept and might include in-class exercise or experiments, writing assignments, or case studies. A subset of active learning is CL. With CL, students work on exercises in small groups. The exercises may be brief ('think, pair, share') or the students may be called upon to resolve a fairly complicated exercise. The common bond among variants is that the students uncover knowledge through small group interaction rather than by passively listening to lectures.

Cobb (1992) has described the need for specific changes in teaching. Instead of traditional lectures where teachers 'tell' students information that

they are to ‘remember’, teachers are encouraged to introduce active-learning activities where students are to construct their knowledge. One way for teachers to incorporate active-learning in their classes is to structure opportunities for students to learn together in small groups. The suggestions made in these reports are supported by a growing set of research studies (over 375 studies) documenting the effectiveness of CL activities in classrooms (Johnson & Smith, 1991).

Majority of the published research studies examine CL activities in basic school, junior high school (JHS), and senior high schools (SHS), and a subgroup of these studies focus on science classes. The implication of these studies is that the use of small group learning activities leads to better group productivity, improved attitudes, and sometimes, increased achievement. One assertion for using cooperative groups relates to the constructivist theory of learning, on which much of the current reform in science education is based. The constructivist theory described learning as actively constructing one’s own knowledge. Constructivists view students as bringing to the classroom their own ideas, experiences, and beliefs that affect how they understand and learn new material rather than ‘receiving’ material in class as it is ‘delivered’. Students restructure the new information to fit into their own cognitive frameworks. In this manner, they actively and individually construct their own knowledge, rather than copying knowledge ‘transmitted or conveyed to them. A related theory of teaching focuses on developing students’ understanding, rather than on rote skill development.

There are several models of CL that vary considerably from each other (Slavin, 1990). In order to have an effective and efficient CL, both the Student Teams–Achievement Divisions (STAD) and the JIGSAW CL models in an

integrated approach are employed. In STAD, students are grouped according to mixed ability. Accordingly, the students are grouped in such a way that all the different ability groups in the experimental classroom were fairly represented in each of the groups formed. The materials (course outline, teaching and learning materials from the resource center and library) are presented and then students worked in their groups and supervise to ensure that all students master the contents. Finally, all the students take individual quizzes/tests (post-intervention test). Students earn team points base on how well they score in the quiz/test compare to past performance (that is the pre-intervention scores). In the JIGSAW model, students are responsible for teaching each other the materials. Assignments are divided into several expert areas and each student is assigned to one area. Experts from different groups meet and discuss their experts' areas. Students then return to their groups and take turns teaching their colleagues. The rationale for the integration of the two models is that while the STAD ensures active group participation, the JIGSAW has the strong potential of enforcing more active individual participation (individual accountability). This necessitates the fact that the students need to collaborate to acquire both the content knowledge and the pedagogical skills. Thus the ability to demonstrate makes one understand any object of concept, skill and generalisation, and enable one to teach it to a different person to also understand equally the same as the teacher. In the integrated approach, every activity or learning task for the group is put in a form of a question/problematic situation so that the students will have a good focus about how to accomplish the task in their respective groups.

Small-group learning activities may be designed to encourage students to construct knowledge as they learn new material, transforming the classroom

into a community of learners actively working together to understand science. The role of the teacher changes accordingly from that of 'source of information' to 'facilitator of learning'. As part of the current mode of assessment of student performance, instructors are being encouraged to collect a variety of information on assessment from sources other than individual student tests. Cooperative group activities may be structured to provide some rich information for teachers to use in assessing the nature of student learning. While walking around the class and observing students as they work in groups, the instructor is able to hear students express their understanding of what they have learned, which provides instructors with an ongoing informal assessment of how well students are learning and underrating scientific ideas. Written reports on group activities may be used to assess students' ability to solve a particular problem; apply a skill; demonstrate understanding of an important concept or use higher-level reasoning skills (Zakaria & Iksan, 2007).

Another reason for using cooperative group learning activities in science classes is that businesses are increasingly looking for employees who are able to work collaboratively on projects and to solve problems as a team. Therefore, it is important to give students practice in developing these skills by working cooperatively on a variety of activities. This type of experience will not only build collaborative problem-solving skills, but will also help students learn to respect other viewpoints, other approaches to solving a problem, and other learning styles. The more one works in CL groups, the more that person learns, the better he or she understands what he or she is learning, the easier it is to remember what he or she learns, and the better he or she feels about himself or herself in the class and his or her classmates. It can

also revitalise studies and faculty by providing a structured environment for sharing some of the responsibilities for learning. Students learn more, have more fun, and develop many works with one another. According to Shaughnessy (1992), CL promotes critical skills, improves classroom results, involves students actively in the learning process, and models appropriate student problem solving techniques. The CL also develops a social support system for students, builds diversity in understanding among students and staff, establishes a positive atmosphere for modeling and practicing cooperation, helps developing learning communities, reduces anxieties, and develops positive attitudes towards teachers (Shaughnessy, 1992).

The use of small-group learning activities appears to benefit students in different ways. These often result in students teaching each other. Those students who take on ‘teaching’ roles find that teaching someone else leads to their own improved understanding of the material. This result is reinforced by research on peer teaching that suggests that having students teach each other is an extremely effective way to increase student’s teaching (Smith, 1989). Having students work together in a group activity often results in a higher level of learning and achievement than could have been obtained individually. A necessary condition for this to occur is called ‘positive interdependence’, the ability of group members to encourage and facilitate each other’s efforts (Johnson, Johnson, & Smith, 1991). Positive interdependence can be promoted by careful design and monitoring of group activities.

Working together with peers encourages comparison of different solutions to scientific problems, solving strategies, and ways of understanding particular problems. This allows students to learn first-hand experiences, show that there is not just one correct way to solve most scientific problems. Small

group activities also provide students with opportunities to verbally express their understanding of what they have learned as opposed to only interacting with materials by listening and reading. By having frequent opportunities to practice and communicate using scientific language, they are able to see where they have not yet mastered the material when they are unable to explain something adequately or communicate effectively with group members. Small-group discussions also allow students to ask and answer more questions than they would be able to in large-group discussions where typically a few students dominate the discussion.

CL provides teachers on the other hand with effective ways to respond to the diverse needs of the student to improve on cross-cultural understanding. Teachers are not alone in coping with the culture shock they feel as they recognise the diversity among their students from diverse backgrounds. Students and teachers need strategies to help turn diversity into a positive force for developing themselves as individuals as well as supporting the growth of others. CL is a powerful educational approach for helping all students attain content standards and develop the interpersonal skills needed for succeeding in a multicultural world.

### **Cooperative Learning Approach and Students' Performance**

CL is grounded in the belief that learning is most effective when students are actively involved in sharing ideas and work cooperatively to complete academic tasks. CL has been used as both an instructional method and as a learning tool at various levels of education and in various subject areas. Central to the goals of CL in science education is the enhancement of performance, problem solving skills, attitudes, and inculcate values. Curiously, despite the attention paid to CL, relatively little research has been



conducted to measure its impact on learning (Maier & Keenan, 1994; Watts & Moore, 1998). Johnston, James, Lye, and McDonald (2000) found that students who participated in collaborative learning tutorials did not perform better in multiple choice questions and evaluative essay questions than those who did not.

How CL affects student performance and problem solving skills was investigated by Effandi (2003). This study of intact groups compared students' science performance and problem solving skills. The experimental section was instructed using CL method and the control section was instructed using the traditional lecture method. Cooperative group instruction showed significantly better results in science performance and problem solving skills. The effect size was moderate and therefore practically meaningful. Effandi (2003) also found that the use of the CL method was a preferable alternative to traditional instructional method. A study has shown that students who were taught with a cooperative structure outperformed the students in individualistic goal structure in science problem solving (Lee, 1999).

Frank (1997) revealed that students who had participated in an in-class experiment on the tragedy of the commons were more likely to perform better in multiple choice questions than students who had been exposed to the learning materials through lectures. Regarding the impact of CL on students' performance, one possible explanation may lie in the work of Marton and Saljo (1996). They distinguished between surface learning and deep learning. According to Marton and Saljo (1996), surface learning refers to students who commit assorted unrelated facts to their short-term memory. Such students are less able to apply theoretical concepts to new contexts. Deep learning implies that students acquire a level of understanding sufficient to apply concepts to

different situations. Surface learning may of course; reflect the demands of the learning task. If the assessment instrument requires surface learning, the students may respond accordingly. In this view, one may wonder if the dependent variable in the empirical studies measures the impact of CL on surface learning or deep learning.

The purpose of the study was to investigate the empirical student performance in principles of microeconomics classes taught via CL versus the traditional lectures. In a full semester, the investigator taught one cohort of micro principles students as a traditional lecture while presenting the course content to the other cohort via CL. A major distinction between this study and previous empirical works is that CL did not serve as a supplement to the traditional lecture. Rather, CL exercises essentially replaced the traditional lecture. The evidence revealed that whereas performance on the multiple choice examinations was fairly comparable, students who were enrolled in the CL class were better able to apply theory on a project that required a higher level of economic reasoning than those who learned the course content through the lecture (Becker & Watts, 1995).

There is a substantial evidence of the research work by Olorukooba (2002), where she indicated that girls favour and achieve higher results in CL than in competitive learning. Thus, CL strategy is found to be gender-friendly. This research work was prompted by the fact that there is the need to improve teaching of science in the country's women's Colleges of Education. This will require that trainee teachers who after their training will be fully engaged in the challenging situations in the classroom, need to be sufficiently resourced with the requisite content and skills, among others to be able to teach basic school science effectively.

### **Cooperative Learning Approach and Students' Attitudes**

Apart from performance and problem solving, students should be inculcated with attitudes and values that are appropriate to their lives as students. Attitude has also been the focus of more than one study in CL. Halim (2000) found that the students in the experimental group held positive attitudes towards science. Azizah (1996) found that CL can inculcate values such as independent, love, and cleanliness. Rahayah (1998) revealed that the values of self-dependence, rational, love and hardworking are prominently inculcated. It was found that CL can enhance scientific skills, promote enquiry learning, and increase science performance. The students were found to enjoy learning in groups.

The essence of CL is the development and maintenance of positive interdependence among team members. A sense of interconnectedness can help students transcend the gender, racial, cultural, and other differences they may sense among themselves. These differences often are at the root of prejudice and other interpersonal stress that students experience in schools. Students need access to activities in which they learn to depend on each other as they ask for and receive help from one another. Individualistic and competitive teaching methods certainly have their place in the instructional programme but they should be balanced with cooperative learning (Johnson & Johnson, & Hollenbeck, 1994). When students work in cooperative teams in which 'all work for one' and 'one for all', team members receive the emotional and academic support that helps them persevere against the many obstacles they face in school. As cooperative norms are established, students

are positively linked to others in the class who will help them and depend on them for completing shared task. When the environment becomes more equitable, students are better able to participate based on their actual, rather than their perceived knowledge and abilities. Teamwork, fostered by positive interdependence among the members, helps students learn valuable interpersonal skills that will benefit them socially and vocationally.

Zaccharria (1970) cited another concept developed by Holland called the theory of personality and model environment. By this theory, the postulation is that at the time of making vocation choice, the individual is the product of the interaction of particular heredity with a variety of culture and personal forces including peers, parents and significant adults, and the physical environment. The theory emphasized the interactional effect of individual's personal characteristics, the physical environments, and the socio-cultural environment in determining their vocational choices.

Another theory that provides theoretical basis for the study is Maslow's theory of career education (as cited by Hoyt, Evans, Mackin, & Manguru, 1974). Maslow maintained that success in working life requires not only the skills needed to perform a job but also the attitude, values and general abilities which lead one to want to work productively and which influence one's ability to function as a productive member of a society over a lifetime. To Maslow, career education is the education that makes available all those pre-requisite attitudes, knowledge, and skills necessary to choose or prepare for and pursue a successful career throughout life. The school can and should constitute to fill in for, and attempt to remedy some of the shortcomings of other segments of the society. According to Hoyt et al. (1974), career education must increase the relevance of school by focusing on the learner's

perception of work and of him as worker career educationalists are mindful of the fact that some learners learn better from 'hands-on' experiences and others from abstract concept.

Students' performance and motivation are often higher in small group activities because students feel more positive about being able to complete a task with others than by working individually (Johnson et al., 1991). Working together towards a mutual goal also results in emotional bonding where group members develop positive feelings towards the group and commitment towards working together. This increase in motivation may also lead to improve student's attitudes towards the subject and course.

### **Summary**

CL is an activity involving a small group of learners who work together as a team to solve a problem, complete a task, or accomplish a common goal (Artzt & Newman, 1990).

CL is simply a 'collaborative learning' which is described as working in small groups, mutually searching for understanding, solution, meaning, or creating a product (Goodshell et al., 1992)

Most CL approaches involve small heterogeneous teams, usually of four to five members, working together towards a group task in which each member is individually accountable for part of an outcome that cannot be completed unless the members work together (Davidson & Kroll, 1991).

When full CL structures are implemented enabling group members discuss the interpersonal skills that influence their effectiveness in working together, the benefit in student achievement often can be astounding (Williams, 2007).

Cobb (1992) has pointed out that teachers need to change the traditional lecture method of teaching, where teachers 'tell' students the information that they are to 'remember' to the methods of teaching, where teachers use active-learning activities, where students are to construct their knowledge.

There are several models of CL that vary considerably from each other. Two of such models are STAD and JIGSAW. The rationale for the integration of the two models is that while the STAD ensures active group participation, the JIGSAW has the strong potential of enforcing more active individual participation (Slavin, 1990).

According to Shaughnessy (1992), CL promotes critical skills, improves classroom results, motivates students in specific curriculum, develops a social support system for students, helps developing learning communities, develops positive attitudes towards teachers, and utilises a variety of assessment techniques.

Students who take on 'teaching' roles in cooperative groups realise that teaching someone else leads to their own improved understanding of the material. This result is reinforced by research work on peer teaching that suggests that having students teach each other is an extremely effective way to increase student's teaching (Smith, 1989).

Johnston et al. (2000) found that students who participated in collaborative learning tutorials did not perform better in multiple choice questions and evaluative essay questions than those who did not.

Cooperative group instruction showed significantly better results in science performance and problem solving skills. The effect size was moderate and therefore practically meaningful (Effandi, 2003).

A study has shown that students who were taught with a cooperative structure outperformed the students in individualistic goal structure in science problem solving (Lee, 1999).

Students found in the CL class were able to apply theory on a higher level of reasoning tasks than those who were taught with the traditional lecture method (Becker & Watts, 1995).

Olorukooba (2002) revealed that female students achieve higher results in CL lessons than in competitive learning lessons.

Azizah (1996) found that CL can inculcate values such as independent, love, and cleanliness.

Rahayah (1998) revealed that the values of self-dependence, rational, love and hardworking are prominently inculcated. It was found out that CL can enhance scientific skills, promote enquiry learning, and increase science performance. The students were found to enjoy learning in groups.

Maslow maintained that success in working life requires not only the skills needed to perform a job but also the attitude, values and general abilities which lead one to want to work productively and which influence one's ability to function as a productive member of a society over a lifetime (Hoyt et al., 1974).

Students' performance and motivation are often higher in small group activities because students feel more positive about being able to complete a task with others than by working individually (Johnson et al., 1991).

## **CHAPTER THREE**

### **METHODOLOGY**

The study intended to improve the performance of trainees of St. Monica's College of Education in Integrated Science through CL under activity method of teaching. The chapter consists of three major components: subjects, procedure, and data analysis. The subjects consist of the population and sample size. The research design, instruments and data collection procedures together constitute the procedure in the study. The method employed in the analysis of the data forms the third component.

#### **Research Design**

The study was aimed at finding out whether CL model can be used to enhance the performance of trainees in Integrated Science at the level of the Colleges of Education. Research questions were formulated and an action research design was subsequently used in answering the research questions. Rapport (1970) described what he emphasized as the 'dual concern' of action research by its nature. In his explanation of the dual concern, he said that action research aims to contribute to both the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually accepted framework. Stenhouse (1985) said that improvement and involvement seem central to all users of the term when he was focusing on the applicability of action research to teaching in isolation. Whyte (1984) stated that central to action research is the requirement for



collaboration between researchers and practitioners, and for practitioner participation in the process.

In addition to the strengths of action research, its democratic aspirations are emphasized by the proponent of action research (Lewin, 1946). He said that action research brings about democracy. Later action researchers such as Robison (1995) saw action research as more of an embodiment of democratic principles in research. He said that the researchers had called for a direct involvement of practitioners in the design, direction, development, and use of research so that the conditions under which they work could be changed. The strength of this design strongly supports the decision confidently taken by the researcher to employ it for a successful research work. That is focusing on the problems identified, implementing the practice(s), and trying to produce change in the setting within which the researcher identified the problem.

Despite all the above advantages of the design chosen, it has been subjected to some form of criticism. Adelman (1989) considered much of educational research to be inward looking and historical and of poor quality. In his view, the claims for action research as an alternative research paradigm, as a democratising force and means of achieving informed, practical change arising from issues at the grass root are over bearing (Robison, 1995). One of the difficulties encountered with this design was how to ensure that the test items for data collection were clear and unambiguous. However, this was accomplished to an extent by ensuring that the test questions were sampled from the set of past questions from the inception of the Diploma in Basic Education (DBE) programme. This is because they significantly test critical thinking and understanding of the teacher trainees in the content knowledge

and pedagogical skills in teaching Integrated Science. Hence the questions focused on recognitions analysis, and informal deductions in teaching Integrated Science. These were put together to help the subjects to concentrate critically on how to learn and teach Integrated Science.

Recognition has to do with how to identify, name, and compare figures on the bases of their appearance as a whole. Analysis concerns itself with pupil's ability to investigate into their properties, establishing the properties of a clean figure empirically and using the properties to solve problems. Informal deductions seek to determine pupils understanding on the relations within and between figures, given informal deductive arguments, and formulation and using definition.

### **Population**

The target population was all the female trainees in all the Colleges of Education in Ghana. However, the accessible population was composed of all the female trainees pursuing the DBE programme at various levels at St. Monica's College of Education. St. Monica's College of Education, which is a women's college is found in Asante Mampong in the Ashanti Region. The school is situated at the Monica's Complex on the Mampong to Nsuta road. It is at the central part of the complex. The complex is made up of the St. Monica's Infant Junior School, St. Monica's Junior Secondary and Senior High School, St. Monica's Babies Home, and St. Monica's Midwifery School.

The number of trainees in the St. Monica's College of Education was 600 for both the continuing and out-programmes trainees for the 2010/2011 academic year. The out-programme trainees were 200 and the rest being continuing trainees. Each year group of the St. Monica's College of Education consisted of five forms lettered from A to E with 40 trainees in each form.

### **Sample and Sampling Technique**

The entire trainees of St. Monica's College of Education were stratified into two major groups; namely the continuing trainees who attended lessons in the morning and afternoon sessions and the out programme trainees who were having their teaching practice at their various stations. Purposive sampling was employed to select the trainees from the first year group. This is because the problem was identified among the first year trainees. The purposive sampling technique did not leave out any subject exposed to the same treatment for the effective change expected to take place in the class.

The problem under study was typically identified at the DBE Form One 'C' class of the St. Monica's College of Education. The class supposedly consisted of trainees who were at the 'bottom' in terms of academic performance, considering all the year groups' academic performances. Two intact forms (1C and 1E classes) of the first year group were involved in the study. The 1C class was used as the experimental group and 1E class was used as the control group. This is because the mean score of the trainees from the 1E class (control group) was higher than the mean score of the trainees from the 1C class (experimental group) in the pretest. The trainees in 1C class were further put into 10 groups of four each. The purpose was to ensure maximum participation and interactions among group members involved in the study. In all 80 trainees comprising 40 trainees respectively in 1C and 1E classes were involved in the study.

### **Research Instruments**

The instrument used for collecting data for the study for both the pre-intervention and the post intervention was a combination of semi-structured questionnaire and an achievement test. The purpose of the questionnaire was

to find out the trainees' impression of the teaching and learning of Integrated Science after they had been taught using the CLA. The use of the achievement test helped to determine the performance of the trainees in Integrated Science. The performances determined assisted in comparing the trainee's performance in the pretest and the posttest.

### **Achievement Test**

The achievement test used for the study was of two types. These were pretest and posttest. There were 10 test items each on the pretest (Appendix A) and the posttest (Appendix B) instruments used. Under each test item, there were three subtest items to be responded to by the trainees.

The test items used for the pretest were sampled from the set of past examination questions since the inception of the Diploma in Basic Education programme on Integrated Science 1 from 2005 to 2010 in the Colleges of Education. The topics were photosynthesis, digestion, reproduction, IUPAC nomenclature, balancing of chemical equations, chemical bonding, mole concept, and measurement. The 10 pretest items covered the cognitive, affective and psychomotor domains. The purpose was to reveal the kind of thinking and understanding the trainee teachers had in learning and teaching Integrated Science at the basic school level. The posttest items were similar to the pretest items and therefore could be said to be of the same difficulty indices. Both tests were administered within duration of 30 minutes. This helped in the analysis of both stages of intervention of the study in order to make a comparison between them.

### **Questionnaire**

A semi-structured questionnaire was developed for the trainees to ascertain their impression about the teaching and learning of Integrated

Science after the CLA has been adopted for the intervention. The questionnaire consisted of 10 items and the trainees were required to tick one of its corresponding responses according to their knowledge and perception and six other items, which required the trainees to provide their own responses. The questionnaire was used for the reason that it is easy for collecting data and trainees may not fear of being victimised as in an interview. It gave the trainees opportunity to express whatever idea they had. It also offered trainees complete anonymity. The trainees had enough time to reflect over questions which helped them to give more meaningful answers.

Though the questionnaire had all these strengths, it also had some weaknesses. An individual or a group selected should be able to provide information about the problem under study else results or findings would not be valid. In all there were 10 close ended items and six open-ended items making a total of 16 items (Appendix C). The open-ended items provided opportunity for trainees in the experimental group to express their opinions on other issues that were not covered in the close ended items. Generally the questionnaire sought views from trainees on the effects of using CL method on the teaching and learning of Integrated Science.

### **Pilot Testing of Instruments**

The research instruments were shown to my supervisor and two Integrated Science tutors of St. Monica's College of Education to assess the items. The purpose was to find out the content and face validities of the instruments. The suggestions and recommendations were used to improve the validity of the instruments.

The pilot testing of the instruments were done at St. Louis College of Education. The St. Louis College of Education was chosen for the pilot testing

because the college has almost the same characteristics as St. Monica's College of Education such as being a female college, a boarding institution, and offering Integrated Science as minor course. Permission was sought from the Principal of the St. Louis College of Education for the pilot testing. There were 10 trainees involved in the pilot testing. The items on the achievement test and the questionnaire were therefore submitted to item analysis. The purpose was to identify the difficult and less difficult items for deletion. After the item analysis, the reliability of the instruments was calculated. The KR20 coefficient reliability was calculated for the achievement test. This is because the test items were scored either wrong or right. The KR20 reliability was calculated as 0.8 and 0.8 respectively for the pretest and posttest. With respect to the reliability of the questionnaire, the Cronbach's alpha coefficient of reliability was used. This is because the items on the questionnaire were not scored either right or wrong. The Cronbach's alpha coefficient reliability for the questionnaire was calculated as 0.7.

### **Time Schedule**

Prior to the actual treatment with the experimental group, strategies were put in place for effective implementation and supervision of the whole study. The instructional time table used in the college revealed that two periods were allocated for Integrated Science lessons in a week; each period was one hour duration.

Since the whole study was designed for eight weeks, the first week (4<sup>th</sup>-8<sup>th</sup> October, 2010) was used to administer and score the pre-test (to both the control and experimental groups) as well as educating the experimental group on the rules and regulations for an effective and efficient CL environment and forming the various smaller groups in the experimental group. In the

subsequent six weeks (11<sup>th</sup> October to 17<sup>th</sup> November, 2010) the treatment was given to the experimental group using the CL models STAD and JIGSAW (Azizah, 2000) while at the same time the control group was taught with the traditional method as it is practised in the college. In the eighth week (25<sup>th</sup>-29<sup>th</sup> November, 2010), the posttest was administered and scored for both the experimental and the control groups. On the 9<sup>th</sup> of December 2010, which was the ninth week of the study the trainees were given the questionnaires to respond to and submit them by the close of the day.

### **Data Collection Procedure**

Empirical study of this nature required that data should be collected on the variables under study for analysis. A letter written by the Head, Department of Science and Mathematics Education, University of Cape Coast, was submitted to the authorities of the St. Monica's College of Education. The purpose of the study was stated in the letter and cooperation of the school authorities was sought. Permission and support were then sought from the teachers and trainees to conduct the study. A briefing session on how to respond to the questionnaire was held with the trainees at the college's Assembly Hall. The research instruments were administered and collected by me. The purpose was to ensure that no special treatment was given to any of the trainees especially during the administration of the achievement tests. All the questionnaires were not retrieved because some of the trainees gave excuses. In all 63 trainees representing 78.8% responded to the questionnaire and returned it. Hence, 21.2% of the trainees failed to return the questionnaire.

### **Pre-intervention**

The pre-intervention stage of the study took place on the 4<sup>th</sup> to 8<sup>th</sup> October, 2010, which was the first week of the study. The trainees were

selected from two intact classes (1C and 1E). The trainees were then briefed on the purpose of the study. The trainees in the two classes who participated in the study were pre-tested at the same time to determine their entry points with respect to the topics at the Colleges of Education. The topics selected such as mole concept and photosynthesis were already treated before 4<sup>th</sup> October 2010. The pre-intervention data collection was organised to ascertain the trainees' performance in Integrated Science.

The pretest was scored immediately after its administration. This helped to establish whether there was any statistical significant difference between the control and the experimental groups.

### **Intervention**

CL is generally understood as learning that takes place in small groups where students share ideas and work collaboratively to complete a given task. There were two steps in the formation of the control and the experimental groups.

#### **Step 1**

Pre-testing was the first step that was taken to select and group the trainees involved in the study into control and experimental groups. This was done by administering a 30 minutes test (pretest) to the two intact classes (1C and 1E) on 8<sup>th</sup> October, 2010. The two intact classes involved in the study were handled by me in the two semesters. The 10 test items were scored out of 100 marks for the two classes.

#### **Step 2**

After scoring the pretest, the mean scores of the two classes were determined. The mean scores calculated for the two classes were statistically significantly not different. These mean scores helped to conveniently assign



the two classes into the experimental (1C) and the control (1E) groups. The class with the higher mean score was the control group and the class with the lower mean score became was the experimental group. Both intact groups were taught the topics: photosynthesis, digestion, reproduction, IUPAC nomenclature, balancing of chemical equations, chemical bonding, mole concept, and measurement for six weeks based on the course outline. However, the experimental group was exposed to the treatment (CL strategies) during the six weeks period (11<sup>th</sup> October to 17<sup>th</sup> November, 2010) of the study while the control group was taught using the traditional lecture method of teaching and learning.

#### **Formation of Heterogeneous Groups and Tutorials within the CL Group**

The trainees were grouped principally according to mixed ability (high and low achievers). This grouping was determined by the nature of the task to be accomplished by the groups, the abilities of the trainees, and the history of the trainees. The concept of having students with different backgrounds, different questions and point of views and different talents working together was to encourage them to challenge each other's thinking and skills. The challenge presented by different thinkers in the group can have the potential of making the CL very successful.

Additionally, the heterogeneous grouping would ensure acceptance of differences among the diverse trainees as they meet to interact with one another in cooperatively structured relationship, thus encouraging social integration. 'Teacher-made' group was used instead of the traditional 'choose your own group'. The latter, choose your own groups, turns out to be the trainees who were very much like each other with the same strengths and same

weaknesses and they often finish their projects or assignments as quickly as they can with a little thought or challenge as possible.

The experimental group was made up of the 40 trainees in the class. The trainees were put in 10 groups of four trainees– the highest number recommended for an effective CL. The entire intervention was strictly guided by the five essential elements of CL proposed by Johnson et al. (1994). It was ensured that the trainees or the various groups conceptualised, reflected, and practiced according to the requirements of these five essential elements of CL. In other words, each of these elements was implemented throughout the entire study in order to have effective CL. The following are the elements and how they were implemented in the Study:

**Positive interdependence:** Here the group was made to understand that each group member depends on each other to accomplish a shared goal or task. In other words the success of one learner was dependent on the success of the other learner.

**Promotive face-to-face interaction:** It was explained to the groups and ensured that individuals could achieve promotive interaction by helping each other's conclusion, providing feedback, encouraging, and striving for mutual benefits. Success of group members was promoted by praising, encouraging, supporting or assisting each other.

**Individual accountability:** it was ensured that throughout the entire work each group member was held accountable for her work. This was accomplished to a far extent by assessing the amount of effort that each member contributed to achieve the success of their respective groups. This was done by giving individual test to each trainee and randomly calling on trainees to present her colleague's work.

Interpersonal and small–group skills (social skills): CL sets the stage for students to learn social skills. These skills helped them to build stronger cooperation among group members. Leadership, decision making, trust building, and communication are different skills that are developed in CL. Opportunities were provided for group members to know each other, accept and support each other, communicate accurately, and resolve differences constructively.

Group processing: This is an assessment of how the groups were functioning to achieve their goals or tasks. The focus of this element was to give the trainees or the groups the golden chance to discuss the special needs or problems within the group. This enabled the group to express their feelings about beneficial and unhelpful outcomes in the group work. Additionally, opportunities were provided for the class to assess group progress. Group processing enabled the groups to focus on good working relationships, facilitate the learning of cooperative skills and ensured that members received feedback.

### **Post Intervention**

At the end of the intervention both groups wrote a test (posttest) on the 27<sup>th</sup> November, 2010. This test purposely evaluated the performances of the experimental and the control groups after the six weeks' instruction. It was to help to find out which of the groups performed better than the other after the intervention. The posttest was made up of 10 items just in the same line as the pretest. They were also selected from the set of past questions since the inception of the Diploma in Basic Education programme (2005-2010), and significantly tested critical thinking and understanding of the trainee teachers

in content knowledge. The posttest items were fairly selected to cover most of the units in the Integrated Science Syllabus.

The duration of the test was 30 minutes. The test was administered to the two intact groups and scored. Trainees were encouraged to do independent work and in order to compare the performance of the experimental and the control groups. The two sets of test were scored and analysed.

The trainees were gathered at the College's Assemble Hall where they were briefed on the purpose of the questionnaire. The trainees were encouraged to respond to the questionnaire truthfully as much as possible. The 16 item questionnaire was then given to the trainees after the administration of the posttest. The purpose was to determine the attitude of the trainees towards the teaching and learning of Integrated Science after the intervention.

### **Data Analysis**

The Mann-Whitney U test analysis, mean, and standard deviations were used to analyse data for the Research Question 1, which sought to find out whether the CLA improved the performance of the trainees in Integrated Science or not. It also helped to determine whether there was any significant difference between the performance of the trainees in both the control and the experimental groups.

The Research Question 2 was analysed with graphs, frequencies, and percentages. This helped to establish the attitudes and motivation of the trainees towards the teaching and learning of Integrated Science.

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

This chapter deals with the presentation of the results of the performance of the teacher trainees in both pretest and posttest in some selected topics in Integrated Science. Also, the results on the effects of CLA on the attitude of the teacher trainees towards Integrated Science are presented in this chapter. Answers to the research questions on trainees' performance in and attitude towards Integrated Science are presented in this chapter using percentages, frequencies, means, standard deviations, and graphs. The Mann-Whitney U test was further used to answer the research question on trainees' performances in the pretest and the posttest. The differences between the experimental and the control groups on both the pretest and the posttest have been presented and discussed in this chapter.

**Research Question One:** Is there significant difference between the mean scores of the teacher trainees of St. Monica's College of Education taught Integrated Science using Cooperative Learning Approach and the teacher trainees taught using the lecture method?

#### **Performance of Teacher Trainees in Some Selected Topics in Integrated Science**

Research Question 1 sought to find out the performance of trainees in some selected topics in Integrated Science after they had been taught for some weeks using the CLA. To answer this research question, two groups of the

trainees (that is the control and the experimental groups) were first given pretest items to respond to. The purpose was to find out whether there was any difference between the control and the experimental groups prior to the intervention stage of the study. The results of the mean performances of the trainees from the two groups in the pretest are presented in Table 1.

**Table 1: Mean Performances of Trainees from the Control and Experimental Groups in the Pretest**

Group	N	M	SD	Max score
Control	40	13.5	7.8	31
Experimental	40	11.5	7.7	31

From Table 1, with a mean of 13.5 (SD = 7.8, Max score = 31), two-thirds of the trainees in the control group could be said to be found between the range of 5.7 and 21.3. The mean for the trainees in the experimental group was calculated as 11.5 (SD = 7.7, Max score = 31). This gave an indication that two-thirds of the trainees in the experimental group could be found within the range of 3.8 to 19.2. The findings in Table 1 show that there was a difference between the performances of the trainees from both the control and the experimental groups at the beginning of the study. To find out whether the difference was statistically significant, the performances of the trainees from the control and the experimental groups were therefore subjected to Mann-Whitney U test analysis. The Mann-Whitney U test analysis was used because, in the first place, intact classes were used. Secondly, when the distribution of the scores from the pretest was tested using the Kolmogorov-Smirnov test, the

value, 0.000 was calculated for both the control and the experimental groups. The calculated value of 0.000 was lower than the significant value of 0.05, which gave an indication that the normality of the distribution of the trainees' scores on the pretest has been violated and therefore the independent-samples t-test cannot be used to test for the difference. The results of the Mann-Whitney U test analysis are presented in Table 2.

**Table 2: Results of the Mann-Whitney U Test of the Control and Experimental Groups on Trainees' Performances in the Pretest**

Group	N	Mean rank	Z	p-value
Control	40	43.1	-1.0	0.306*
Experimental	40	37.9		

\* Not significant,  $p > 0.05$

The results in Table 2 show that there was no statistical significant difference between the performance of the trainees from the control and experimental groups in the pretest. This is because the mean rank, 43.1 (Mann-Whitney U = 694.5, Z = -1.0, p = 0.306) of the trainees from the control group was not statistically significantly different from the mean rank, 37.9 of the trainees from the experimental group in the pretest on some selected topics in Integrated Science. This means that the trainees from both the control and the experimental groups were of the same performance prior to the intervention stage of the study.

The Research Question 1 further sought to find out the performances of the teacher trainees in a posttest on some selected topics in Integrated

Science after the intervention (that is CLA) has been administered to the experimental group. Table 3 presents the results on the mean performances of the trainees from the control and the experimental groups in the posttest.

**Table 3: Mean Performances of Trainees from the Control and Experimental Groups in the Posttest**

Group	N	M	SD	Max score
Control	40	15.0	8.9	42
Experimental	40	35.4	9.3	49

From Table 3, with mean of 15.0 (SD = 8.9, Max score = 42), almost two-thirds of the trainees from the control group could be said to be found in the range of 6.1 to 23.9. For the experimental group, it could be seen from Table 3 that with a high mean of 35.4 (SD = 9.3, Max score = 49), about two-thirds of the trainees scored marks in the range of 26.1 to 44.7 in the posttest. The findings from Table 3 show that there was a difference in the mean performances between the trainees from the control group and that of the experimental group. The Mann-Whitney U test analysis was therefore used to find out whether the difference was statistically significant. Table 4 presents the results of the Mann-Whitney U test analysis on the posttest scores of the trainees from both the control and the experimental groups.

The results in Table 4 show that there was a statistically significant difference between the performance of the trainees from the control and experimental groups in the posttest. This is because the mean rank (mean rank = 23.0, Mann-Whitney U = 99.0, Z = -6.8, p = 0.000) of the trainees from the



control group was less than the mean rank, 58.0 of the trainees from the experimental group in the posttest on some selected topics in Integrated Science.

**Table 4: Results of the Mann-Whitney U Test of the Control and Experimental Groups on Trainees’ Performances in the Posttest**

Group	N	Mean rank	Z	p-value
Control	40	23.0	-6.8	0.000*
Experimental	40	58.0		

\* Significant,  $p < 0.05$

The findings from Table 4 show that the trainees from the experimental group performed better in the posttest than their counterparts from the control group. This shows that the performance of the trainees in the experimental group was enhanced after they had been taught using the CLA, and hence the intervention had a positive impact on the trainees’ performance in the selected topics in Integrated Science.

**Research Question Two:** To what extent does cooperative learning approach enhance the attitude and motivation of teacher trainees of St. Monica’s College of Education towards Integrated Science?

#### **CLA and Trainees’ Attitudes towards Integrated Science**

The Research Question 2 sought to find out whether CLA has enhanced the attitudes of the trainees toward the teaching and learning of Integrated Science, and therefore has motivated the trainees to learn Integrated

Science. To be able to answer this research question, the trainees were given a 16-item questionnaire to respond to (see Appendix C).

The item 1 sought to find out whether learning in groups helped the trainees to better understand concepts in Integrated Science as compared to individualised learning. The results are presented in Table 5.

**Table 5: Better Understanding of Scientific Concepts in Group Learning than Learning Alone (N = 63)**

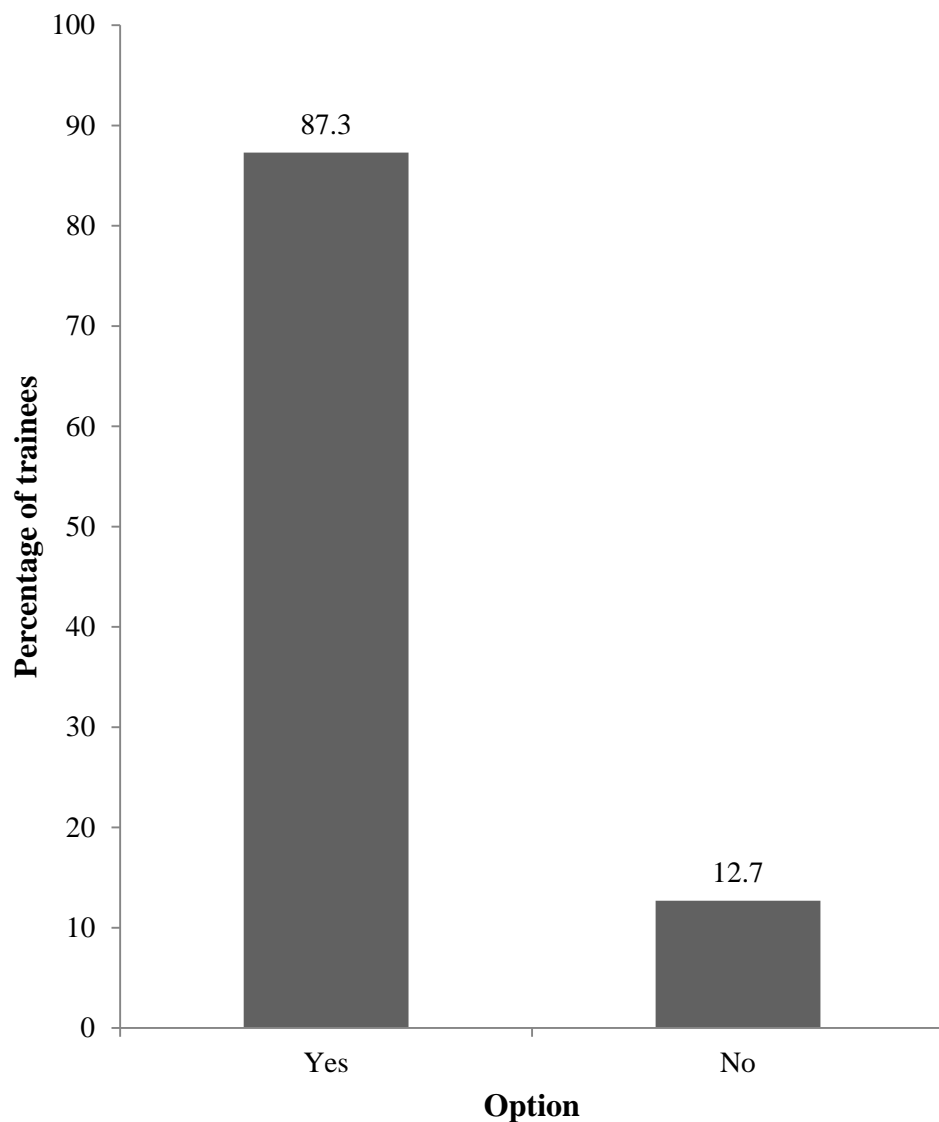
Option	N	%
Always	17	27.0
Sometimes	46	73.0
Never	-	0.0
Not Aware	-	0.0
Total	63	100.0

From Table 5, 27.0% of the trainees indicated that scientific concepts are better understood when they are learnt in groups as compared to an individual learning them alone. Hence, 73.0% of the trainees indicated that sometimes learning concepts in science are better understood when studied in groups as compared to an individual learning alone. The findings from Table 5 show that the trainees appreciated that learning in groups help them to understand concepts in science better but not all the time. This could be attributed to the perception that the trainees are used to learning scientific

concepts alone, and that science teachers are usually perceived to give individual assignments as compared to group work.

Item 2 also sought to find out whether learning in groups was beneficial as compared to individualised learning or not. Figure 1 presents the results of the trainees' responses on this item.

From Figure 1, it could be seen that an overall 87.3% of the trainees indicated that they benefit more from group learning than individual learning. Hence, only 12.7% of the trainees indicated that they do not benefit much from learning in groups as compared to learning individually.



**Figure 1. Bar graph on how beneficial group learning is compared to individualised learning.**

The findings from Figure 1 show that learning scientific concepts and principles during the teaching and learning of Integrated Science is much more beneficial to the trainees than to learn them individually. Science teachers are therefore encouraged to incorporate group learning in the teaching and learning of scientific concepts and principles. This is because it helps trainees to construct their own knowledge, and in effect help them better understand scientific concepts and principles.

Item 3 further sought to find out the trainees' reasons for indicating either yes or no for the assertion that group learning was beneficial than individualised learning during the teaching and learning of Integrated Science. The reasons given by the trainees were categorised into 'better understanding', 'acquire new knowledge' and 'others'. The results on the reasons given by the trainees on group learning was beneficial over learning individually are presented in Table 6.

**Table 6: Reasons for the Assertion that Group Learning is Beneficial over Individualised Learning (N = 63)**

Reason	N	%
Better understanding	25	39.7
Acquire new knowledge	26	41.3
Others	12	19.0

Total	63	100.0
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From Table 6, 39.7% of the trainees perceived that learning in group during the teaching and learning of Integrated Science was beneficial over learning individually because when the trainees learnt scientific concepts and principles in groups, they understood the concepts and the principles better. An overall 41.3% of the trainees also perceived that when they learnt scientific concepts and principles in groups during Integrated Science lessons, they acquired new knowledge. Only 19.0% of the trainees gave varying reasons such as communicate very well, listen attentively, share ideas, and feel free to express the ideas. The findings from Table 6 show that majority (41.3%) of the trainees agreed that learning scientific concepts and principles in Integrated Science lessons in groups was beneficial over individualised learning. This is because the trainees perceived that in group learning they acquire new knowledge in and better understanding of scientific concepts and principles.

Item 4 sought to find out whether the trainees learn quicker and retain more knowledge in small cooperative groups for Integrated Science quizzes or not. The results on item 4 are presented in Table 7.

**Table 7: Retention of Knowledge in Small Cooperative Groups (N = 63)**

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Option	N	%
Always	21	33.3
Sometimes	40	63.5
Never	1	1.6
	61	

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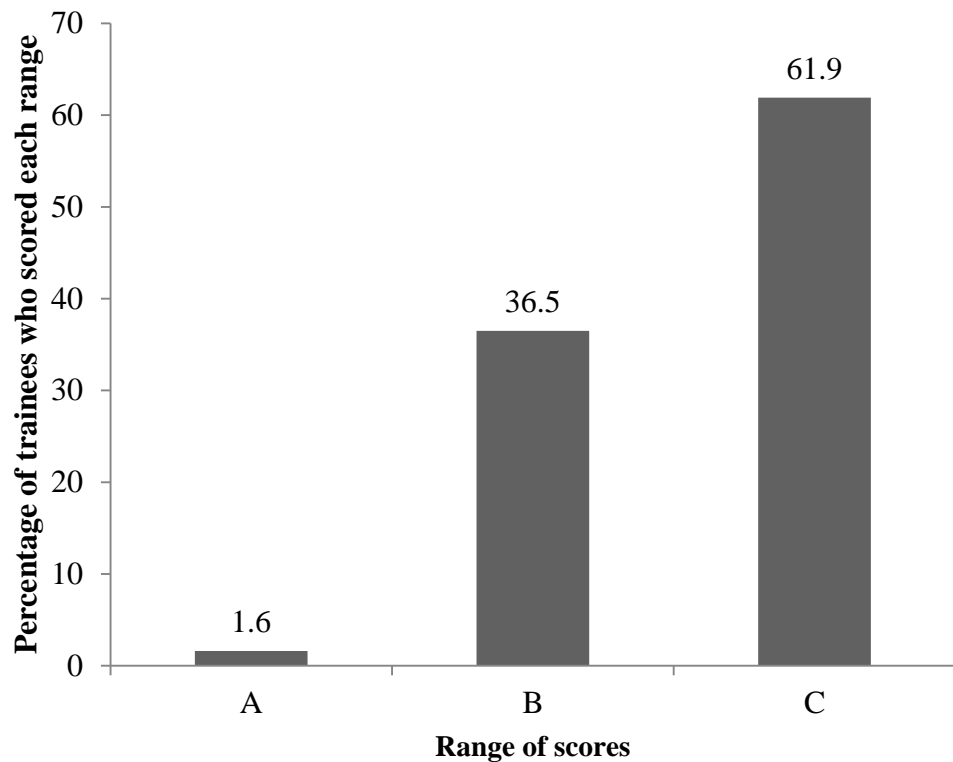
Not aware	1	1.6
<hr/>		
Total	63	100.0
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The results in Table 7 show that 33.3% of the trainees indicated that they always learn quicker and retain more knowledge in small cooperative groups for Integrated Science quizzes. An overall majority (63.5%) of the trainees indicated that they sometimes learn quicker and retain more knowledge in small cooperative groups for Integrated Science quizzes. Only one of the trainees respectively indicated respectively that she was never or not aware that he or she learns quicker and retains more knowledge in small cooperative groups for Integrated Science quizzes. The findings from Table 7 show that majority (63.5%) of the trainees appreciated that they sometimes learn quicker and retain knowledge in small cooperative groups. This could be attributed to the perception that the trainees are not used to learning in groups, and that not all scientific concepts and principles in Integrated Science could be learnt through CL.

The score of the trainees in Integrated Science class exercise was investigated with item 5. The total score for the class exercise was 10 and the score of the trainees out of the 10 marks was grouped as 1-4, 5-7, and 8-10. The results of the trainees' scores in the class exercise are presented in Figure 2, where A, B, and C correspond to 1-4, 5-7, and 8-10 respectively.

From Figure 2, only 1.6% of the trainees scored marks ranging from 1-4 and 36.5% of the trainees scored marks ranging from 5-7 in the Integrated Science class exercise. An overall 61.9% of the trainees scored marks ranging from 8-10. The findings show that the trainees performed very well in the

class exercise. This is because majority (61.9%) of the trainees scored higher marks in the class exercise.



**Figure 2. A bar graph of the scores of trainees in an Integrated Science class exercise.**

Item 6 sought to find the performance of the trainees in terms of the grades the trainees obtained in Integrated Science for the first year end of first semester examination. Table 8 presents the results on the grades obtained by the trainees.

The results in Table 8 show that only 3.2% of the trainees were referred in the first semester Integrated Science. This is because two of the trainees obtained grade E in the end of semester Integrated Science examination. From Table 8, 11.1% of the trainees obtained grade A, which was an excellent performance; 36.5% of the trainees obtained grades B-B<sup>+</sup>,

which were good performances; 30.2% of the trainees were graded C-C<sup>+</sup>, which were satisfactory performances; and 19.0% of the trainees were graded D-D<sup>+</sup>, which were pass performances.

**Table 8: Grades of the Trainees in Integrated Science for the First Semester (N = 63)**

Grade	N	%
A	7	11.1
B-B <sup>+</sup>	23	36.5
C-C <sup>+</sup>	19	30.2
D-D <sup>+</sup>	12	19.0
E	2	3.2
Total	63	100.0

The findings in Table 8 show that the trainees perform creditably well in Integrated Science End of Semester Examinations. This is because majority (47.6%) of the trainees obtained grades from A-B with only two of the trainees been referred in the end of semester examinations.

Item 7 sought to find out whether the Integrated Science teachers engaged the trainees in group activities during Integrated Science lessons or not. The results of the students' perception with respect to being engaged in group activities by the science teachers are presented in Table 9.

From Table 9, it could be seen that only 9.5% of the trainees indicated that the science teachers always engaged the trainees in group activities during



the teaching and learning of Integrated Science. An overall 84.1% of the trainees indicated that the science teachers some of the time engaged the trainees in activities that are group work. Hence, only 6.4% of the trainees indicated that the science teachers never engaged the trainees in any group activities during the teaching and learning of Integrated Science. To one of such trainees even if the science teachers did, she was not aware.

**Table 9: Teachers' Engagement of the Trainees in Group Activities (N = 63)**

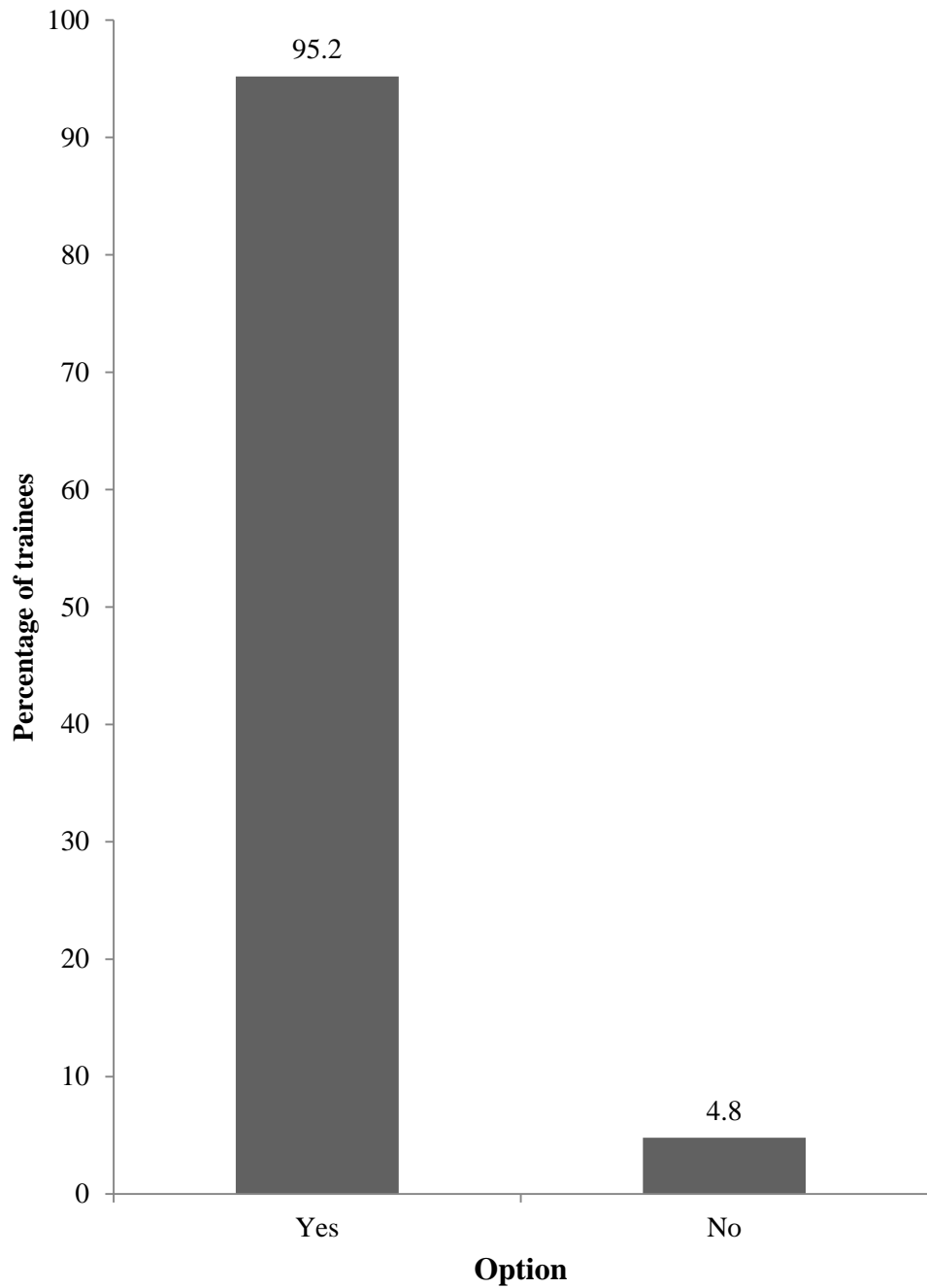
Option	N	%
Always	6	9.5
Sometimes	53	84.1
Never	3	4.8
Not aware	1	1.6
Total	63	100.0

The findings show that group activity is present in Integrated Science lesson but it occurs once a while. This is because a larger percentage (84.1%) of the trainees indicated that group activity occurs sometimes during the teaching and learning of Integrated Science. This could be attributed to the fact that group activity is time consuming and when use, the teachers could not finish the course outline for Integrated Science.

Item 8 sought to find out whether the trainees acquired new ideas from their group mates or not during the group activities that the trainees performed

when the CLA was introduced. The results of the trainees' responses on the item 8 are presented in Figure 3.

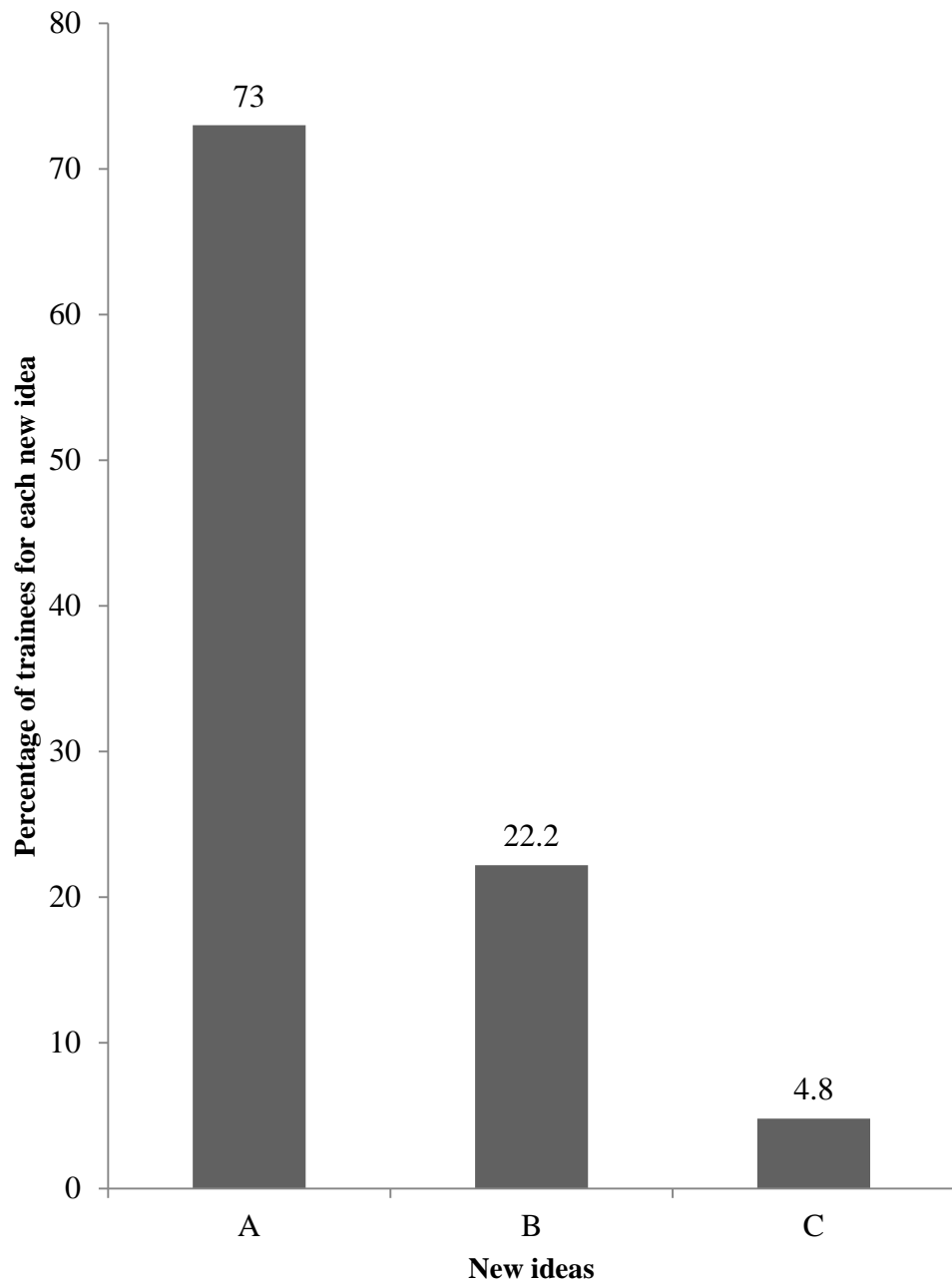
From Figure 3, it could be seen that an overall 95.2% of the trainees indicated that they acquire new scientific ideas from the group mates during the Integrated Science lessons where group works were involved. Hence, only 4.8% of the trainees indicated that the trainees do not acquire any new scientific ideas from the group mates. This could be attributed to the fact that during group discussion or work, the trainees share ideas on scientific concepts and principles.



**Figure 3. A bar graph on the trainees acquiring new ideas from team mates.**

Item 9 further sought to ascertain the kind of new ideas that the trainees acquired from the group mates when the CLA was adopted. The new ideas stated by the trainees were grouped as ‘new ways of solving problems’, ‘better understanding’, and ‘others’. The results on the new ideas acquired by

the trainees from the group mates are represented in Figure 4 as A for new ways of solving problems, B for better understanding, and C for others.



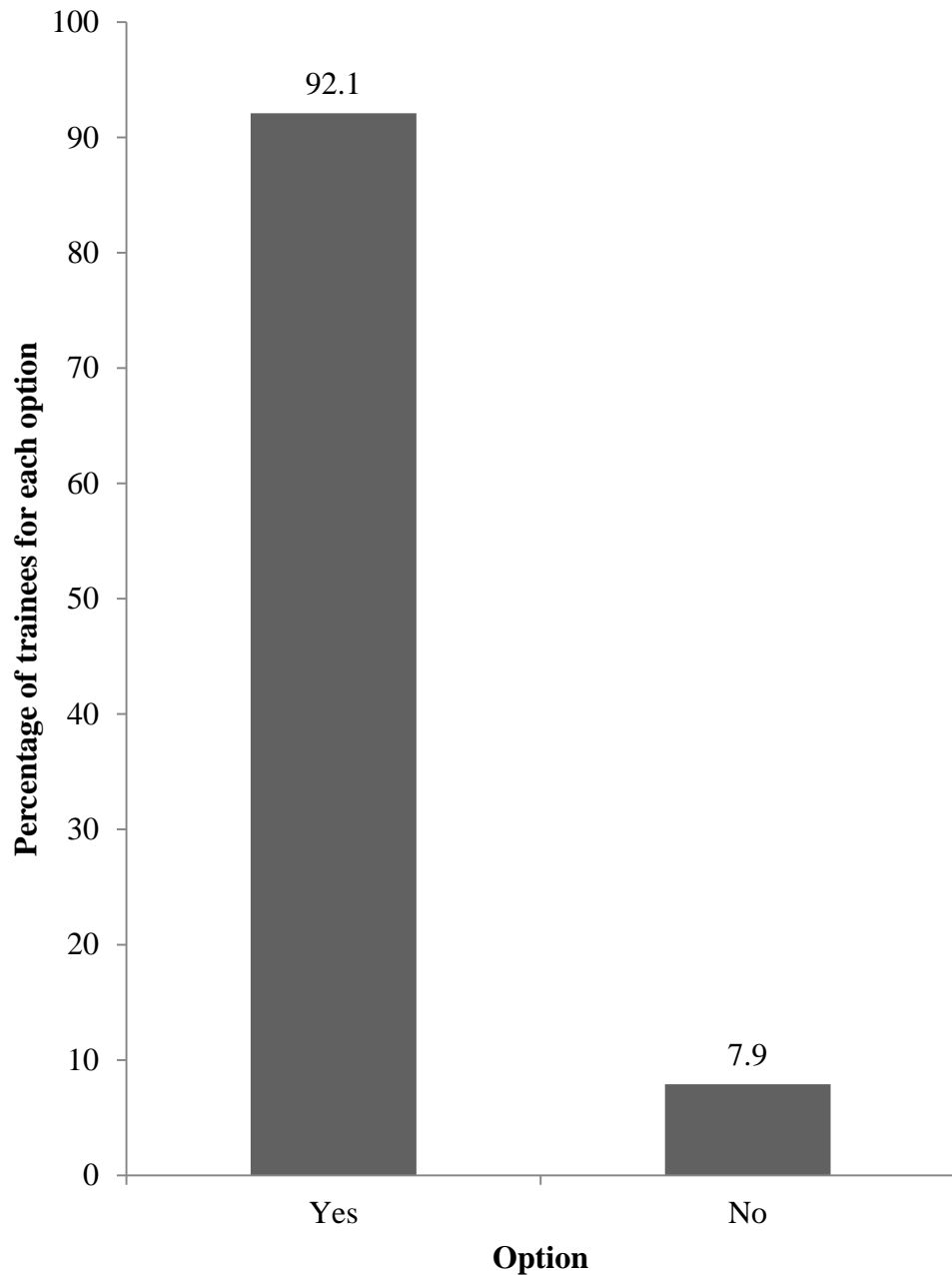
**Figure 4. A bar graph of new ideas acquired by the trainees from group mates.**

From Figure 4, an overall 73.0% of the trainees stated that the trainees acquire new ways of solving problems by interacting with group members as the new scientific ideas they acquired from the group mates. Only 22.2% and 4.8% of the trainees respectively stated that the trainees understood scientific

concepts better and others as their new ideas. Hence, the new ideas acquire by the trainees from the group mates when CLA is used could be said to be the acquisition of new ways of problem solving. This could be explained on the grounds that in group discussions or activities, group members always come out with alternate means of solving an identified problem.

Item 10 sought to find out whether the trainees encountered any form of competition among the group members or not. Figure 5 presents the results on the competitiveness that could have occurred among the trainees in each small cooperative group.

From Figure 5, an overwhelming majority (92.1%) of the trainees indicated that the trainees encountered competitions among the group mates when the group activities were performed. Hence, only 7.9% of the trainees indicated that there were no competitions among the group members during the group discussions or activities. The findings show that competitions usually build up among group members whenever the CLA is used in the teaching and learning of Integrated Science. This is because in CL no individual is allowed to dominate the discussion or the activity, and hence, every trainee would like to contribute to make the discussion or the activity a healthy one. Such all on board group activity or discussion could result in a healthy competition.

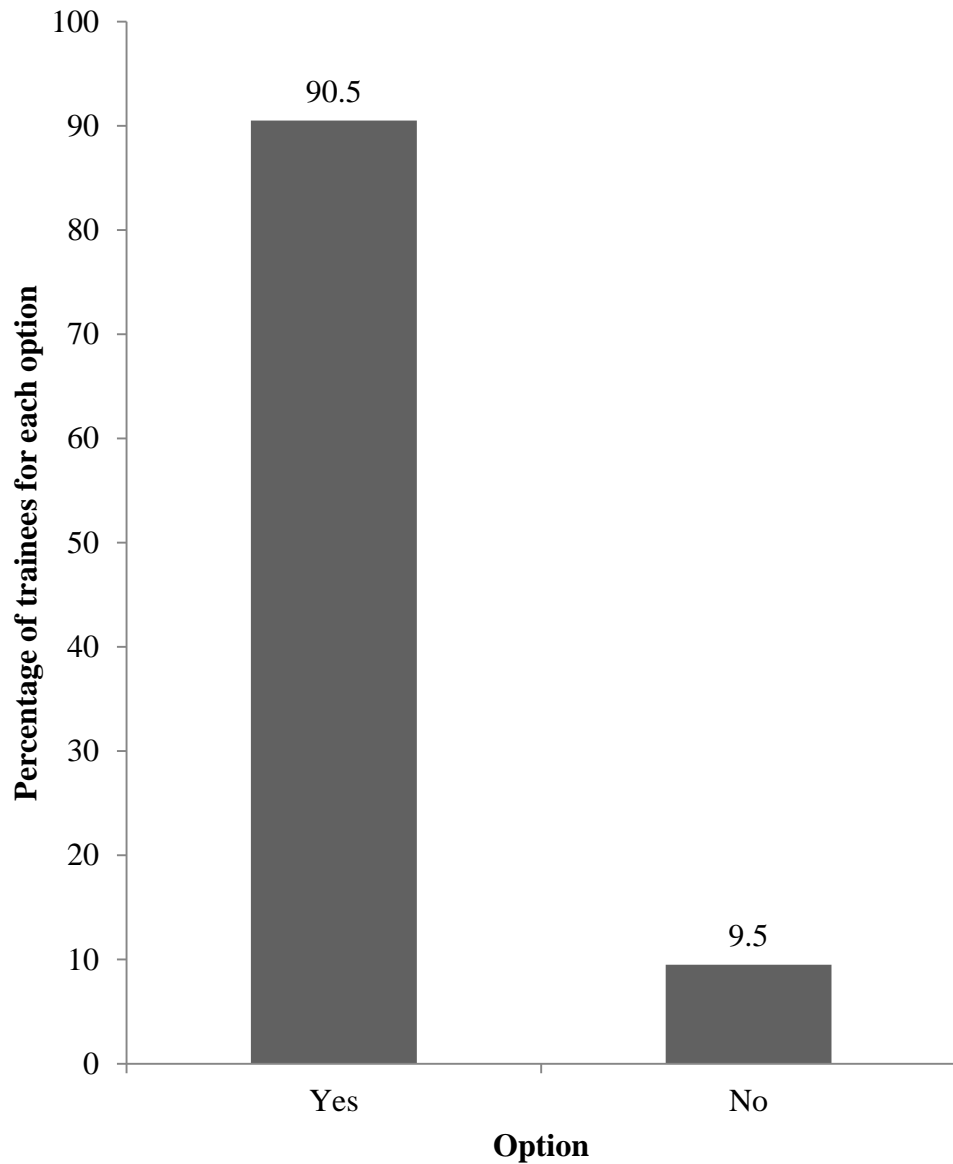


**Figure 5. A bar graph of competition among group members.**

Item 11 sought to find out whether the trainees prefer learning in small cooperative groups or not. The results of the trainees' preference on learning in small cooperative groups are presented in Figure 6.

It could be seen from Figure 6 that an overall 90.5% of the trainees indicated that the trainees preferred learning in small cooperative groups. Hence, only 9.5% of the trainees indicated that they do not prefer to learn in

small cooperative groups. The findings show that the trainees prefer to learn in small cooperative groups. This could be attributed to the fact that the trainees have realised that learning in small cooperative groups could help acquire new ideas in the form of new ways of solving problems.



**Figure 6. A bar graph of the trainees' preference to learning in small cooperative groups.**

The reasons for the trainees' preference to learning in small cooperative groups were ascertained using item 12. The reasons given by the trainees for preferring to learn in small cooperative groups were grouped as

‘active participation’, ‘share new ideas’, ‘better understanding’, and ‘others’.

The results on the reasons given by the trainees are presented in Table 10.

**Table 10: Trainees’ Reasons for the Preference for Learning in Small Cooperative Groups (N = 63)**

Reason	N	%
Active participation	15	23.8
Share new ideas	25	39.7
Better understanding	19	30.2
Others	4	6.3
Total	63	100.0

From Table 10, 23.8% of the trainees said that the trainees preferred to learn in small cooperative groups because the trainees actively participate in the group activities or discussions. The results in Table 10 further show that 39.7% of the trainees said that in small cooperative learning the trainees share new ideas among the group mates and this was why the trainees preferred to learn in small cooperative groups. Another percentage of the trainees (that is 30.2%) preferred learning in small cooperative groups because the trainees acquired better understanding in such groups. Hence, only 6.3% of the trainees cited variable reasons such as free communication, listen attentively, and respect for each other’s views. The findings in Table 10 show that the trainees prefer to learn in small cooperative groups because of the possibility of share



of ideas among group mates, better understanding of scientific concepts and principles, and active participation of the trainees in the lessons.

Item 13 sought to find out the advantages the trainees drew from learning Integrated Science in cooperative groups. The advantages the trainees assigned to CL were grouped as ‘acquisition of new ideas’, ‘better expression of oneself’, ‘faster learning rate’, ‘promotion of tolerance’, and ‘others’. Table 11 presents the results on the advantages of the CL to the trainees.

**Table 11: Results on the Advantages of Learning in Cooperative Groups  
(N = 63)**

Advantage	N	%
Acquisition of new ideas	17	27.0
Better expression of oneself	18	28.6
Faster learning rate	14	22.2
Promotion of tolerance	10	15.9
Others	4	6.3
Total	63	100.0

From Table 11, 27.0% of the trainees said that it was an advantage to learn in cooperative groups because the trainees acquired new ideas; 28.6% of the trainees said that cooperative learning helped the trainees to express themselves better; 22.2% of the trainees said that learning in the cooperative groups was very fast; and 15.9% of the trainees said that learning in cooperative groups promoted tolerance among the group members. Hence,

only 6.3% of the trainees gave varying advantages to learning in cooperative groups, which were grouped as ‘others’. The findings show that the advantages of learning in cooperative groups to the trainees could be ranked as better expression of oneself, acquisition of new ideas, faster learning rate, and promotion of tolerance. The ranks were deduced from the percentage of the trainees who stated the said advantage as seen from Table 11. Therefore it could be said that one main advantage of CL to the trainees is promotion of better expression of oneself among the group members.

Item 14 sought to find out the disadvantages that the trainees encountered in learning scientific concepts and principles in cooperative groups in Integrated Science lessons. The disadvantages of learning in cooperative groups as identified by the trainees were grouped as ‘unseriousness’, ‘time consuming’, ‘weak trainees not allowed to share their views’, ‘misunderstanding’, and ‘others’. The results on the disadvantages of learning in cooperative groups as identified by the trainees are presented in Table 12.

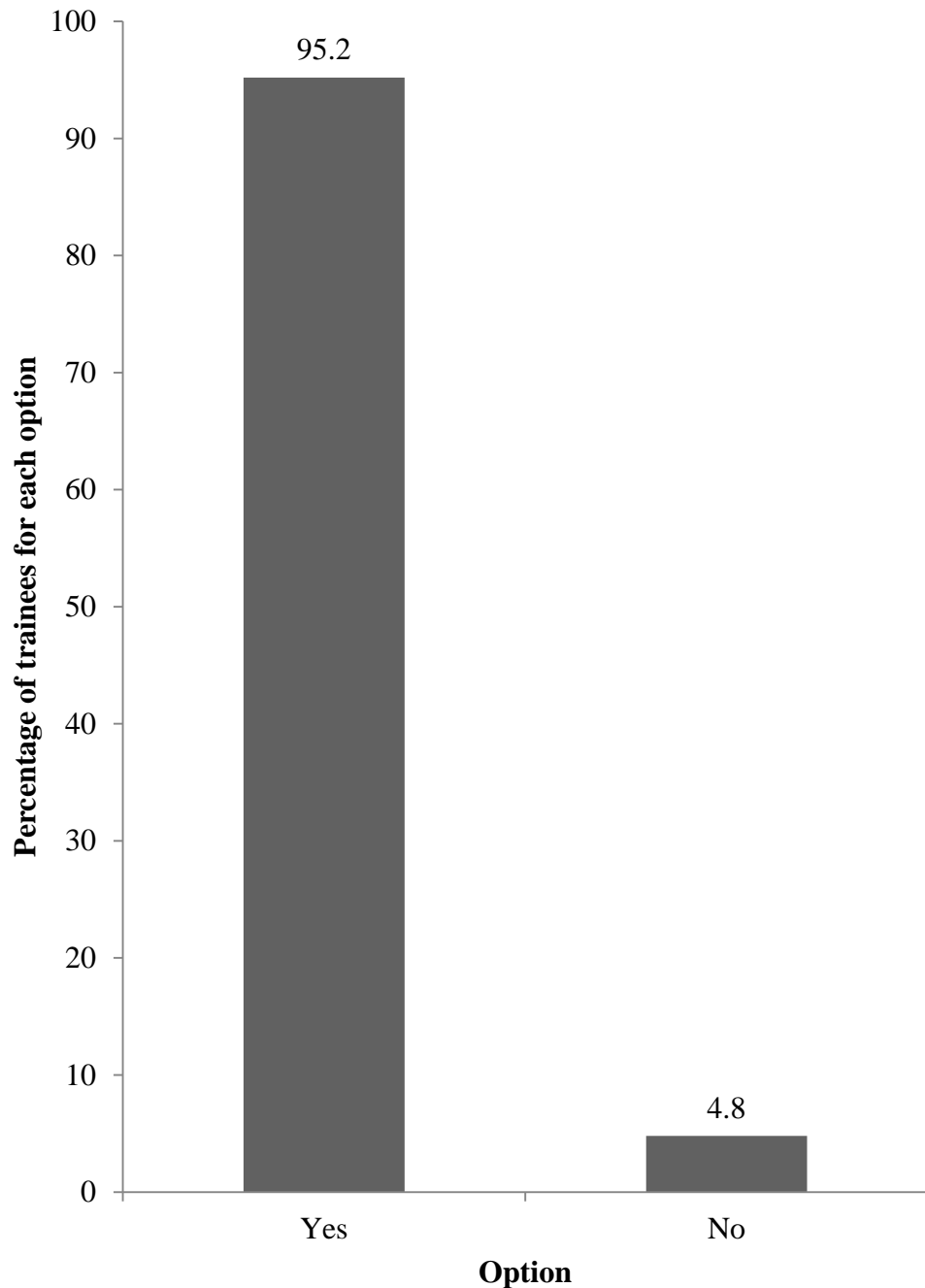
**Table 12: Results on the Disadvantages of Learning in Cooperative Groups (N = 63)**

Disadvantage	N	%
Unseriousness	14	25.4
Time consuming	17	27.0
Weak trainees not allowed to share views	12	19.0
Misunderstanding	10	15.9
	74	

Others	8	12.7
<hr/>		
Total	63	100.0
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From Table 12, 25.4% of the trainees said that a lot of the trainees were not serious during group discussions or activities; 27.0% of the trainees said that learning in cooperative groups was time consuming, and that every trainee needed to contribute in one way or the other during group activities or discussions; 19.0% of the trainees said that the weak trainees were intimidated and that they were not allowed to share their ideas in the groups as the members of the group thought that the input of such weak trainees could go against their respective groups; and 15.9% of the trainees said that the trainees experienced some form of misunderstanding as the group mates who put forward some scientific ideas were not in the position to explain such ideas better to the other group members. From Table 12, 12.7% of the trainees stated some varying disadvantages such as shyness, not all topics could be learnt through the CL, and learning in cooperative groups could be chaotic, which were grouped as others. The findings in Table 12 show that the disadvantages of learning in cooperative groups could be ranked as time consuming, unseriousness on the part of the trainees, weak trainees not allowed to share ideas, and misunderstanding. The ranks were deduced with respect to the percentage of the trainees who stated the said disadvantage as seen from Table 12. From the ranks, it could be said that one major disadvantage of learning in cooperative groups is its time-consuming nature. This could be attributed to the fact that each member of the group is expected to have maximum interaction with other group members and materials.

Item 15 sought to find out whether the trainees recommend the use of CL in the teaching and learning of Integrated Science at the Colleges of Education or not. The results are presented in Figure 7.



**Figure 7. A bar graph on the recommendations made by the trainees on CL at the Colleges of Education.**

The results in Figure 7 show that an overwhelming majority (95.2%) of the trainees recommended the use of CL at the Colleges of Education. Hence,

only 4.8% of the trainees did not recommend the use of CL at the Colleges of Education. This could be attributed to the advantages the trainees realised that they could draw when they learn scientific concepts and principles in cooperative groups.

Item 16 sought to find out the reasons for the trainees' recommendation for the use of CL at the Colleges of Education. The reasons given by the trainees were grouped as 'better understanding', completion of course outline', 'assistance to weak ones by bright trainees', and 'others'. Table 13 presents the results on the reasons given by the trainees for the recommendation for the use of CL at the Colleges of Education.

**Table 13: Reasons for the Trainees' Recommendation for the use of CL at the Colleges of Education (N =63)**

Reason	N	%
Better understanding	45	71.4
Completion of course outline	8	12.7
Assistance to weak ones by bright trainees	8	12.7
Others	2	3.2
Total	63	100.0

From Table 13, 71.4% of the trainees indicated that the trainees recommended the use of CL at the Colleges of Education because of the better

understanding it offered the trainees. The results further show that 12.7% of the trainees respectively indicated that they recommend the use of CL at the Colleges of Education because through the use of CL the weak trainees were offered assistance by the bright ones, and that CL promoted the completion of the Integrated Science course outline. Hence, only 3.2% of the trainees indicated other varying reasons for the recommendation for the use of CL at the Colleges of Education. Therefore the findings show that the trainees recommended the use of CL at the Colleges of Education because of the better understanding it offers the trainees.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

This chapter presents the summary of the study, conclusions, and recommendations based on the key findings. Provision is also made for suggestions for further study.

#### **Summary**

The study investigated the impact of using cooperative learning to promote active learning among the teacher trainees of St. Monica's College of Education in Integrated Science. The sample size for the study consisted of 80 first year trainees. The 80 trainees were further grouped into control and experimental groups consisting of 40 trainees each. Achievement test and questionnaire were used as the main instruments for the study. Out of the 80 trainees, only 63 trainees' responses to questionnaire were analysed.

The main design for the study was action research. The pretest instrument was used at the pre-intervention stage to find whether there was any difference in performances between the trainees from the control group and that of the experimental group. At the intervention stage, the trainees were taught some topics; namely mole concept, IUPAC naming of compounds, respiration, and photosynthesis using the CLA. The posttest was administered at the post-intervention stage to ascertain whether the use of CLA has had the needed impact on the trainees' performance in Integrated Science. After the posttest administration, the questionnaire was used to find out the attitudes and motivation of the trainees towards the teaching and

learning of Integrated Science. The action research provided the study with both qualitative and quantitative data.

### **Key findings**

The key findings from the study are:

1. a. There was no the statistically significant difference between the performance of the trainees from the control and experimental groups in the pretest. This is because the mean rank of the trainees from the control group was not statistically significantly different from the mean rank of the trainees in the experimental group.
- b. There was statistically significant difference between the performance of the trainees from the control and experimental groups in the posttest. This is because the mean rank of the trainees from the control group was less than the mean rank of the trainees in the experimental group in the posttest on the selected topics in Integrated Science.
2. For those who were taught using the CLA, the following findings were arrived at:
  - a. Majority of the trainees indicated that teaching and learning of scientific concepts and principles were better understood some of the time in group learning than in individualised learning.
  - b. Group learning of scientific concepts and principles was much more beneficial to the trainees than to learn them individually.
  - c. Group learning of scientific concepts and principles was beneficial over individualised learning because the trainees in the groups acquire new knowledge in and better understanding of scientific concepts and principles.



- d. Majority of the trainees appreciated that they sometimes learn quicker and retain knowledge in small cooperative groups for Integrated Science quizzes.
- e. Great majority of the trainees indicated that their science teachers some of the time engaged them in group activities.
- f. The trainees acquired new scientific ideas from the group mates in group discussions or works in Integrated Science lessons.
- g. The trainees indicated that the new scientific idea acquired by the trainees from the group mates in CL was the acquisition of new ways of problem solving.
- h. Majority of the trainees indicated that competitions built up among group members in small cooperative groups in the teaching and learning of Integrated Science.
- i. Large number of the trainees preferred to learn in small cooperative groups.
- j. The trainees preferred to learn in small cooperative groups because of the possibility of share of ideas among group mates, better understanding of scientific concepts and principles, and active participation of the trainees in the lessons.
- k. The advantages of learning in small cooperative groups were identified as better expression of oneself, acquisition of new ideas, faster learning rate, and promotion of tolerance.
- l. The major advantage of CL was identified as better expression of oneself.

- m. The disadvantages of learning in cooperative groups were identified as time consuming, unseriousness on the part of the trainees, weak trainees not allowed to share ideas, and misunderstanding.
- n. The main disadvantage of CL was time consuming.
- o. The trainees recommended the use of CL at the Colleges of Education.
- p. The trainees recommended the use of CL at the Colleges of Education because of the better understanding it offers the trainees.

### **Conclusions**

The study has revealed that the Cooperative Learning Approach helped the trainees involved in the study to improve on their performance in Integrated Science. This is because the performance of the experimental group improved significantly compared to the control group after the intervention. This confirms the findings of Becker and Watts (1995); Effandi (2003); and Lee (1999), which show that students who were found in small cooperative groups performed better than their counterparts who were allowed to study individually or were lectured.

In this study, the Cooperative Learning Approach enhanced the attitude and motivation of the trainees towards the teaching and learning of Integrated Science, which confirms the findings of Halim (2000) that the students in the experimental group developed positive attitudes towards Integrated Science. This is because the trainees said that they acquired new ideas to solving problems and had better understanding of scientific concepts and principles. This confirms one of the importances of learning in small cooperative groups as revealed by the study conducted by Shaughnessy (1992), which states that the CL models appropriate student problem solving strategies. The attitudes

and motivation of the trainees towards the learning of Integrated Science could be said to have improved after they had been taught using the CLA because of the fact that the trainees interacted among themselves and materials in the small cooperative groups, and the kind of competition that ensued among them. This confirms the individualistic and competitive nature of CL as put forward by Johnson et al. (1994). The trainees recommended that the CLA should be adopted at the Colleges of Educations due its advantages such as better expression of oneself, acquisition of new ideas, and promotion of tolerance.

### **Recommendations**

The following recommendations are made based on the findings of the study:

1. As the CLA helped improved the performance of the trainees in photosynthesis, digestion, reproduction, IUPAC nomenclature, balancing of chemical equations, chemical bonding, mole concept, and measurement in Integrated Science. Hence, science teachers of St. Monica's College of Education should adopt the CLA in the teaching and learning of these topics in Integrated Science.
2. The Principal and the Head of Science Department of the St. Monica's College of Education should organise workshops and in-service trainings on the CLA to enable the science teachers appreciate the advantages of the CLA to the teaching and learning of Integrated Science.
3. The science teachers should use the CLA regularly as the study revealed that the teachers some of the time use cooperative groups in the teaching and learning of Integrated Science.

### **Suggestions for Future Research**

The study investigated the effects of CLA on the trainees' performance in Integrated Science at the Colleges of Education in Ghana. However, the study did not consider the difficulties of the science teachers in using CLA to teach Integrated Science at the Colleges of Education. It is therefore recommended that a future research is conducted to look into the difficulties of the teachers in teaching Integrated Science using the CLA.

The study was conducted in the St. Monica's College of Education, which limited the generalisation of the findings from the study to cover all the Colleges of Education in Ghana. It is therefore recommended that a future research is conducted involving other Colleges of Education for the possibility of wider generalisation of the findings from the study.

The study was conducted using photosynthesis, digestion, reproduction, IUPAC nomenclature, balancing of chemical equations, chemical bonding, mole concept, and measurement. However, the study did not consider topics such as water, acids, bases and salts, structure and reactions of organic compounds, circulatory, nervous, and excretory systems. It is therefore recommended that future research is conducted to determine the effectiveness of the CLA in teaching these other topics in Integrated Science.

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## APPENDICES

## APPENDIX A

### PRETEST INSTRUMENT AND ITS SOLUTION

This achievement test seeks to find out your performance in some test items on photosynthesis, digestion, reproduction, IUPAC nomenclature, balancing of chemical equations, chemical bonding, mole concept, and measurement. Please, your responses should be written in the spaces provided. Your performance will be used for research purposes only. Your identity is not required, and therefore you are to respond to the items to the best of your ability. You will be given **30** minutes to respond to the items after which your paper will be collected.

#### Test Items

1. Define the following terms

a.

Photosynthesis.....

b.

Assimilation.....

c.

Reproduction.....

2. Distinguish between the following pair of terms

a. Net and parallel venation.....

b. Digestion and egestion.....

3. Describe how you will test for protein in a sample of non-powdered milk using the Burette test.....

4. Give the IUPAC names of the following compounds:

i.  $\text{MnO}_2$

ii.  $\text{KMnO}_4$

iii.  $\text{Cu}_2\text{O}$

5. The symbols and atomic numbers of five elements are shown below:

$_{10}\text{Ne}$ ,  $_{11}\text{Na}$ ,  $_{12}\text{Mg}$ ,  $_{15}\text{P}$ ,  $_{17}\text{Cl}$

i. Give the formula of an ionic chloride that can be formed by the elements.

ii. Give the formula of a covalent chloride that can be formed by the elements

iii. Give the name of an element which does not readily form compounds from the list

6. Balance the following equations:



7. Calculate the concentration in grams per  $\text{dm}^3$  of 0.40mol NaOH dissolved in  $800\text{cm}^3$  of solution. (Na = 23, O = 16, H = 1)

8. State the instrument you will use to measure each of the following quantities

i. Thickness of a 500 cedi coin

ii. Length of a thin copper wire

iii. Intensity of light in a room

9. What is meant by the dimension of a physical quantity?

.....  
.....

10. Obtain the dimensions of the following quantities?

- i. Density
- ii. Force
- iii. Acceleration

### Solution to Pretest Items

1. (a) Photosynthesis is the process by which green plants manufacture sugar from carbon dioxide and water with the aid of sunlight trapped by chlorophyll.

(b) Assimilation is how the digested food materials are used by the body.

(c) Reproduction is the process of producing new generation of individuals of the same species

2. (a) Net venation is the arrangement of veins of the lamina of dicotyledonous leaf whereas parallel venation is the arrangement of veins in the lamina of monocotyledonous leaf.

b. Digestion is the process by which complex organic food substances are masticated and hydrolysed by digestive enzymes into simple whilst egestion is the removal of undigested and digested but unabsorbed food substance from the body usually through the anus.

3. Test for protein in non-powdered milk,

**Materials:** Test tube, sodium hydroxide solution, copper solution, milk

**Procedure:**

- Place  $2\text{cm}^3$  of the milk into a test tube and add a few drops of 2% sodium hydroxide solution and mix.

- Add 1% copper sulphate solution drop by drop, shaking at each drop.

**Observation:**

A purple or violet coloration will appear

**Conclusion:**

The colour change indicates the presence of protein

4. Manganese (IV) oxide

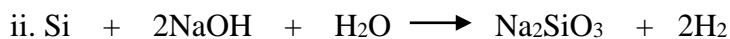
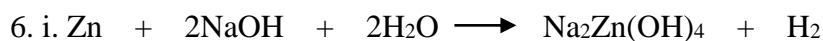
i. Potassium tetraoxomanganate(VII)

ii. Copper (I) oxide

5. NaCl, MgCl<sub>2</sub>

i. PCl<sub>3</sub>, PCl<sub>5</sub>

ii. Neon



7. Volume of solution = 800cm<sup>3</sup>

$$1000\text{cm}^3 = 1\text{dm}^3$$

$$800\text{cm}^3 = \frac{800\text{cm}^3}{1000} \times 1\text{dm}^3$$

$$= 0.8\text{dm}^3$$

$$\text{Mass of NaOH} = \text{Number of moles} \times \text{molar mass}$$

$$= 0.4\text{mol} \times M(23 + 16 + 1)$$

$$= 0.4\text{mol} \times 40\text{g/mol}$$

$$= 16\text{g mol}^{-1}$$

$$\text{Concentration in g/dm}^3 = \frac{\text{mass}}{\text{V}(\text{dm}^3)}$$

$$= \frac{16\text{g}}{0.8\text{dm}^3}$$

$$= 20\text{g/dm}^3$$

$$= 20\text{g/dm}^3$$

8. i. Micrometer screw gauge

ii. Tape measure/metre-rule

iii. Photometer

9. The dimension of a physical quantity is the way the physical quantity is related to the fundamental quantity length, mass and time.

10. i. [Density] =  $\frac{\text{mass}}{\text{Volume}}$  =  $\frac{\text{M}}{\text{L}^3}$  =  $\text{ML}^{-3}$

$$\text{Volume } \text{L}^3$$

ii. [Force] = mass x acceleration

$$= \text{MLT}^{-2}$$

$$= \text{ML}^{\text{T}-2}$$

iii. [Acceleration] =  $\frac{\text{velocity}}{\text{Time}}$  =  $\frac{\text{LT}^{-1}}{\text{T}}$  =  $\text{LT}^{-2}$

$$\text{Time } \quad \text{T}$$

## **APPENDIX B**

### **POSTTEST INSTRUMENT AND ITS SOLUTION**

This achievement test seeks to find out your performance in some test items on photosynthesis, digestion, reproduction, IUPAC nomenclature, balancing of chemical equations, chemical bonding, mole concept, and measurement. Please, your responses should be written in the spaces provided. Your performance will be used for research purposes only. Your identity is not required, and therefore you are to respond to the items to the best of your ability. You will be given **30** minutes to respond to the items after which your paper will be collected.

#### **Test Items**

1. Define the following terms:
  - a. Autotrophs
  - b. Heterotrophs
  - c. Saprophytes
2. Differentiate between the following pairs of terms:
  - i. ingestion and egestion
  - ii. Absorption and assimilation
3. Describe how you will test for protein using the million's test.



4. Give the IUPAC names of the following compounds.

i.  $\text{PbCl}_4$

ii.  $\text{CuO}$

iii.  $\text{H}_2\text{SO}_4$

5. The symbols and atomic numbers of five elements are shown below:  ${}_{18}\text{Ar}$ ,

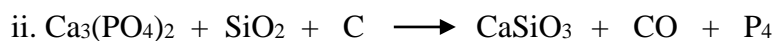
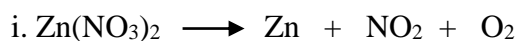
${}_{19}\text{K}$ ,  ${}_{15}\text{P}$ ,  ${}_{17}\text{Cl}$

a. Give the formula of an ionic chloride that can be formed by the elements.

b. Give the formula of a covalent chloride that can be formed by the elements.

c. Give the name of an element which does not readily form compounds from the list.

6. Balance the following chemical equations:



7. Calculate the concentration in grams per  $\text{dm}^3$  of 0.25mol  $\text{Ca}(\text{OH})_2$  dissolved in  $500\text{cm}^3$  of solution ( $\text{Ca} = 40$ ,  $\text{O} = 16$ ,  $\text{H} = 1$ )

8. What measuring instrument will you use to measure each of the following?

i. Relative density of a liquid

ii. Weight of body

iii. Atmospheric pressure

9. Describe how you will determine the density of a rectangular bar without using the displacement method

.....

.....

.....

.....

10. Deduce the dimensions of the following quantities

- i. kinetic Energy
- ii. Pressure
- iii. Momentum

### **Solution to Posttest Items**

1. a. Autotrophs: these are organisms which make their organic food from inorganic substances
- b. Heterotrophs: these are organisms which require readymade organic foods or organisms which cannot build up their dead organic matter.
2. i. Ingestion is the taking in food while egestion is the removal of undigested food substances from the body through the anus.
- ii. Absorption is the movement of simple soluble substances into the blood lymph system while Assimilation is the use of the absorbed food by the cells of the body.

**Material:** Million's reagent, eggs, test tube, source of heat.

#### **Procedure**

- Add millions reagent to a colloidal solution of an egg albumen
- Heat

#### **Observation**

White cloudy ppt turn's deep red on heating

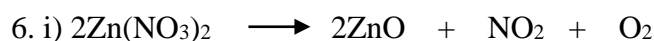
#### **Conclusion**

Protein is present.

4. i) Lead (IV) chloride
  - ii) Copper (II) oxide
  - iii) Tetraoxosulphate (VI) acid
5. i) KCl

ii)  $\text{PCl}_3$ ,  $\text{PCl}_5$

iii) Argon



$$\begin{aligned} 7. \text{ Volume} &= 500\text{cm}^3 \text{ into } \text{dm}^3 = \frac{500\text{cm}^3}{1000\text{cm}^3} \times 1\text{dm}^3 \\ &= 0.5\text{dm}^3 \end{aligned}$$

$$\text{Molar mass (Ca (OH)}_2) = 40 + 2(16) + 2(1) = 74\text{g/mol}$$

$$\text{Amount of substance (s)} = \frac{\text{Mass (m)}}{\text{Molar mass (m)}}$$

$$\begin{aligned} \therefore \text{Mass} &= n \times m \\ &= 0.25\text{mol} \times 74\text{g/mol} \\ &= 18.5\text{g} \end{aligned}$$

$$\begin{aligned} \text{Concentration in g/dm}^3 &= \frac{\text{Mass}}{\text{Volume}} \\ &= \frac{18.5\text{g}}{0.5\text{dm}^3} \\ &= 37\text{g/dm}^3 \end{aligned}$$

8. i) Hydrometer

ii) Spring balance

iii) Simple barometer

9. The volume of the rectangular bar will be calculated from measurements of length, breadth and height made by vernier calipers and meter rule. The mass of the rectangular bar will be found by weighing it on a beam balance. Then the formula for density = mass/volume will be used to calculate the density of the rectangular bar.

$$\begin{aligned}
 10. \text{ i. [Kinetic energy]} &= \frac{1}{2} MV^2 \\
 &= M (LT^{-1})^2 \\
 &= ML^2T^{-2}
 \end{aligned}$$

$$\begin{aligned}
 \text{ii. [Pressure]} &= \frac{\text{Force}}{\text{Area}} \\
 &= \frac{MLT^{-2}}{L^2} \\
 &= MLT^{-2}L^{-2}
 \end{aligned}$$

$$\begin{aligned}
 \text{iii. [Momentum]} &= \text{Mass} \times \text{velocity} \\
 &= M \times LT^{-1} \\
 &= MLT^{-1}
 \end{aligned}$$

## **APPENDIX C**

### **THE QUESTIONNAIRE**

The study is designed to enable the researcher who is a graduate student of University of Cape Coast (UCC) to obtain information on Cooperative Learning in Colleges of Education. The researcher will be grateful if you could respond to all the items as candid as you can. All responses will be used solely for the purpose of the research and they will be treated confidentially. Hence, you need not write your name on the questionnaire.

#### **Instructions**

Respond to all the items by ticking one of the options of each item provided, or write short responses in the spaces provided where appropriate.

1. Does learning in groups help you to better understand concepts in integrated science than learning alone?

[ ] Always

Sometimes

Never

Not Aware

2. Is group learning beneficial over learning individually

Yes

No

3. If yes give reasons.....  
.....  
.....

4. Do you learn quicker and retain more knowledge in small co-operative groups for integrated science quizzes

Always

Never

Sometimes

Not Aware

5. What has been your range of marks scored out of ten in integrated science exercises conducted in class?

1-4

5-7

8-10

6. What was your grade in Integrated Science for the first year end of first semester examination?

A

B-B+

C-C+

D-D+

E

7. Does your teacher engage you in group activities during integrated science lessons?

Always

Sometimes

Never

Not aware

8. Do you get new ideas from your team mates?

Yes

No

9. If yes, what new ideas do you get from your team mates?

.....  
.....  
.....

10. Do you encounter competitions among your team mates?

Yes

No

11. Do you prefer learning in cooperative small groups?

Yes

No

12. If yes give reasons.....

.....  
.....

13. What are some of the advantages that you got in learning in cooperative groups?

.....  
.....  
.....

14. What are some of the disadvantages in learning in cooperative groups?

.....  
.....  
.....

15. Do you recommend cooperative learning to be used in learning Integrated Science at the Colleges of Education level?

Yes

No

16. If yes give reasons.....

.....  
.....