TITLE PAGE

EFFECT OF COLLABORATIVE LEARNING STRATEGY ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN MATHEMATICS

BY

OKEKEAJI APPOLONIA CHIDUM
PG. 2009627002F

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APPROVAL PAGE

This dissertation has been approved in partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy (Ph.D) in the Department of Guidance and Counselling, Faculty of Education, Nnamdi Azikiwe University, Awka, Anambra State.

By

_____ _____

Prof. Anagbogu, M.A. Date
Supervisor

_____ _____

Rev. Sr. Dr. Obineli S.U. Date
Head of Department

_____ _____

Prof Ifeluni, I. K. Date
External Examiner

_____ _____

Prof. Ibeneme, O.T. Date
Dean Faculty of Education

_____ _____

Prof. Anike, L.A. Date
Dean PG School

CERTIFICATION

This is to certify that I am responsible for the work submitted in this dissertation. The original work is entirely mine except as specified in the references and acknowledgements. No part of this work had been submitted to this University or any other University for the award of any degree in Education.

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Name Signature

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Date

DEDICATION

This study is dedicated to my husband, children and my beloved parents, Late Chief Sir, Ben Ezechikwelu Osude and Lolo Marcillina Osude.

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ABSTRACT

The problem of poor achievement among secondary school students in mathematics calls for innovative, practical and student centred approach using collaborative learning strategy. The quasi experimental study with pretest post-test design study was conducted to determine effect of collaborative learning strategy on secondary school students' academic achievement in mathematics in Anambra State. Four research questions and seven hypotheses guided the study. The sample size consisted of 173 Senior Secondary One (SS I) students drawn through purposeful sampling technique from four co-educational secondary schools in Awka Education Zone of Anambra State. Data were collected using a Teacher Made Achievement Test (TMAT) validated by experts and duely tested for reliability. The reliability value was 0.80(STAD), 0.76 (JS), 0.73(NHT). The data collected were analyzed using mean scores for Research questions. ANCOVA was utilized in testing the hypotheses. The result indicated that Student Team Achievement Division (STAD), Jigsaw (JS), Number Heads Together (NHT) aspects of collaborative learning strategy are very effective in enhancing students' academic achievement in mathematics. That STAD was most effective when compared with JS and NHT in enhancing students academic achievement in mathematics. The result also revealed that STAD, JS and NHT do not differ significantly in enhancing students academic achievement in mathematics. Based on the findings and implications, it is necessary for guidance counsellors to start early to counsel students on the use of collaborative learning strategy in their learning of mathematics. School counselors should also incorporate collaborative learning strategy as part of study habit technique in helping students enhance their academic achievement in mathematics.

CHAPTER ONE

INTRODUCTION

Background to the Study

Mathematics has been identified as one of the most important subjects in Nigeria education system from primary to tertiary institutions (Iqabl, 2004). Unfortunately, students have been achieving poorly in this subject. The poor achievement in mathematics has been attributed to factors such as inadequate number of teachers, insufficient teaching facilities, poor study habits and poor teaching methods. Apparently, the poor performance had caused anxiety, frustration, withdrawal from lessons and even resulted in students choosing subjects or courses not related to mathematics. In addition, many students especially those who are science inclined find it rather difficult to gain admission into higher institutions of learning because they could not meet up with Joint Admission and Matriculation Board (JAMB) requirements.

Researchers (Effandi, La Chung & Yusoff, 2010), saw the significance of forestalling the deteriorating achievement through the use of curriculum restructuring, teaching effectiveness, use of students' friendly instructional materials and mathematics anxiety reduction method. Parents on the other hand resorted to spending a lot of money in private mathematics lessons for their children. All these attempts have not made any recognizable impact, since, students' poor performance in 2011 West African Senior Secondary Certificate Examination (WASSCE) showed that only 38.93% of 587830 candidates who sat for May/June 2011 WASSCE in Nigeria obtained C_6 and above in Mathematics

(Ebimomi, 2011). Also Junior Secondary School Certificate Examination (JSSCE) result analysis of Community Secondary School Okpuno (CSS Okpuno), Community Secondary School Agulu-Awka (CSS Agulu-Awka), Capital City Secondary School Awka (CSS Awka) and Ezi-Awka Community Secondary School Awka (ECSS Awka) for a period of three years (2009 – 2011) (Appendices D-F) showed that students have consistently been performing below 10% credit level pass in mathematics. The academic achievement in mathematics however, may be regarded as knowledge gained, skill acquired or developed in mathematics usually measured using test, examination, and compared against a standard (C_6 and above). The poor achievement apparently calls for more innovative strategy that is student oriented, which will make them participate actively, be committed and contribute effectively for better achievement in mathematics. The innovation will be contrary to the conventional method which is characterized by individualism and unhealthy competitions. Students applying conventional method study only to pass examination and aim at performing better than the rest of their classmates. The individualistic environment does not give room to mutual interaction learning, rather, it creates a lot of gaps between the high achievers (those who score above 55%) and the low achievers (those who persistently score less than 40%). The individualistic efforts could not ameliorate the problem. The researcher therefore hopes that the poor achievement could be enhanced through the application of collaborative learning strategy.

Collaborative learning according to Baer (2003) is simply the coming together of few students in a group for the purpose of learning. It is an umbrella

term for a variety of education approaches involving joint intellectual efforts by students or students and teachers together. Collaborative learning is a type of learning which involves pairing and grouping of learners mutually searching for understanding, solutions or meaning or creating one product or the other. Collaborative learning also is defined by Hatano and Inagaki (2003) as an instructional method which learners at various performance levels work together in small groups of 2 – 5 towards a common goal. It is an academic relationship or interaction in groups. Strategy according to Arauz (2012) is the practice of figuring out the best way to carry out an activity. It is a set of planned actions. Collaborative learning strategy therefore is a set of planned actions/activities, ways, methods or techniques by which students in their groups figure out the best way to help one another to achieve collaborative learning. To the present researcher, collaborative learning strategy is defined as different techniques student adopt during their private learning in small groups that enable them to study harder not only to learn but to help each other to succeed. It can be looked at as approaches through which academic relations/interactions are carried out. Collaborative learning strategy is based on the premise that knowledge can be created in groups through many techniques. In the groups, members actively interact, discuss and share experiences.

Some of the approaches/techniques of collaborative learning strategy which students apply during their learning include: Think Pair Share (TPS), Number Heads Together (NHT), Three-Step Interview (TSI), Round Table Structure (RTS), Send a Problem (SAP), Focus Listing (FL), One Minute Papers (OMP),

Peer Teaching (PT), Discussion Groups and Seminars (DGAS), Project Groups (PG), Pair Checks (PC), Cooperative Review (CR), Jigsaw (JS), Student Team Achievement Division (STAD), Team Game Tournament (TGT) (Kagan,1994) among others. The present study focused on the application of Students' Team Achievement Division, Jigsaw and Number Heads Together in the learning of mathematics. These three techniques actively involve students participation more and easily expose loofers.

STAD is a collaborative learning technique whereby students are shared in heterogeneous groups of not more than five members to achieve a common goal. In this structure a topic is presented, students work within their teams to make sure every member mastered it, and is ready for individual quiz. In Jigsaw, students are shared into a four member team to each work on segmented academic materials. The segments are assigned to members in the teams. Those with similar segments form expert groups to not only learn the material but learn how to teach them to others. After the learning exercise the team members reconvene to their mother groups, to teach other members. NHT emphasizes "putting heads together" by students in answering questions or solving problems. Members are numbered off 1 – 4. Those with identical numbers form within teams. A topic is presented, members discuss the topic, agree on the answer and all get prepared to defend their group when called up. Unlike STAD, NHT has rehearsals to determine further mastery by students before the individual quiz. STAD works with only the original group, then individual quiz. Jigsaw operates in two groups – mother groups and expert groups.

Collaborative Learning strategy does not mean just belonging to a group, sitting, chit-chatting, claiming work done by others; rather active participation (intelligent, constructive arguments and criticisms) and concentration are needed on the part of all the members of the group. It is an interaction among learners that requires positive interdependence (members depending on each other for information), individual accountability (each accounting for his contribution or responsibilities) personal skills (team building, communication, problem solving) face to face promotive interaction (group growth interaction) and group process (evaluation and decisions) (Johnson & Johnson, 1990). Moreso, Johnson, Johnson and Holubec, (1998) reported that students rely on each other in collaborative learning strategy. If any member fails to carry out his task the entire group members would bear the brunt. Students are therefore faced with learning tasks, talking and discussing. It is through talking and discussing that they learn. Students in discussion groups have diverse backgrounds, learning styles, experiences and aspirations which are healthy to learning through different "sizes-fit-all" approaches. This learning strategy goes beyond mastery of content and ideas. It is more of practical experiences which warrants knowledge transfer. Students capitalize on each others' resources and skills (asking one another for information, evaluating one another's ideas and monitoring one another's work) to own their learning. Collaborative learning strategy also is inherently a social act involving sharing of ideas and information, making decisions, solving exercises in Mathematics textbooks, undertaking assignments together, and filling gaps in each others' knowledge (Brown & Cuiffeteli, 2009; Nwankwo, 2006).

These activities (discussions, questioning, elaboration among others) in collaborative learning strategy stimulate critical thinking and problem solving skills in students, create greater opportunity for them to view situation from others' perspectives, clarify ideas through discussion and debate. For instance, Agulanna and Agbaegbu (2005) supported collaborative learning strategy and stressed that students exposed to such learning exercise perform better than those with the conventional method of studying. Students in collaborative classroom develop self esteem, self confidence and improve their attitudes towards the subject. They feel at home with each other in a learning situation, gender, ethnic group, culture and intellectual level notwithstanding. Group members have opportunity to interact freely, learn from each other and with each other. As such, phobia will be reduced and every student may learn at the same level with other students (Tinzmann, Jones, Fennimore, Bakler, Fine & Pierce, 1990). More importantly, it reduces classroom/subject (mathematics) test phobia, anxieties, and improves students' achievement in the subject as well reduces, the persistent complaints of students concerning poor learning in secondary school mathematics.

In supporting collaborative learning strategy, Vygotsky (1978) observed that learning takes place through social interaction. Hatano and Inagaki (2003) stated that students should learn to be constructors of their own knowledge, active thinkers, interpreters, explorers and social participants in their learning process. For success to be achieved in Mathematics, students should be given opportunity to communicate and reason mathematically, develop self confidence and solve mathematical problems.

Collaborative learning strategy therefore, is understood to be more of student centered and allows open ended interaction, enables students to be active participants in their learning. Students reach out for more information that will help their members understand the subject matter clearly and discover many approaches to problem solving. More importantly, members are expected to strive to contribute during discussions thereby developing their intellect. Many researchers such as Ibraheem (2011), Njoroge and Githua(2013), and Abdullah (2010) conducted studies on the use of collaborative learning strategy in students' retention and retrieval of materials, collaborative learning in tertiary institution, collaborative learning in social studies and other subjects; all focused on collaborative learning strategy as teaching method. None of the studies carried out so far to the knowledge of the researcher was conducted on collaborative learning strategy as study techniques for students during their private studies. It is on this note that the researcher, wishes to investigate whether the strategy if adopted in the learning of mathematics will have effect on academic achievement of students.

Statement of the Problem

Deteriorating achievement of students in mathematics has been of great concern to stateholders in education such as policy makers, guidance counsellors, parents, and to the society at large. The analysis of past achievement patterns in mathematics in Nigeria carried out by Ali (2006) showed that between 1997 and 2001, there was a steady average of 1.7% annual decline in students A_1 to C_6 grades of acceptable achievement in Mathematics in WASSCE. Also result of 2011 WASSCE had it that only 38.93% of 587830 students who took the

examination scored credit and above in mathematics which is not encouraging. Alozie (2013) further reported that 48.88% of 151569 candidates who took mathematics in 2012/2013 WASSCE examination scored C6 and above. Furthermore, the JSSCE three years result analysis 2009 – 2012 (Appendices C – E) collected from four schools in Awka Education Zone,proved the poor achievement of students in mathematics. For the period in question none of the schools recorded up to 10% credit level scores in achievement in mathematics. Similar deterioration in regular Secondary School teacher made achievement test in Mathematics has also been reported by Ali. The persistent failure rate made many students to shy away from the subject and conclude that it is very difficult to learn. As such students prefer studying other subjects to the detriment of mathematics. This attitude encouraged poor performance in teacher made achievement tests, JSSCE, WASSCE and NECO.

Different efforts made to forestall the devastating situation have not yielded any visible result. Researchers like Effandi, La Chung and Yusaff(2010) introduced anxiety reduction methods, curriculum restructuring, among others; Post Primary Schools Service Commission in conjunction with the Ministry of Education organized seminars and conferences for teachers on the use of students' friendly teaching methods and appropriate use of teaching aids. Inspite of all these efforts, students still fail mathematic?

The researcher as a Guidance Counsellor is very much worried at the rate of students' poor achievement records in mathematics. Besides, many students visit her office with series of problems concerning poor performance in mathematics.

Based on these, the researcher concluded that there is a missing link. She became motivated to seek for more practical approaches to the students' problems (involving students in solving their mathematical problems themselves in groups during their private studies), using STAD, JS and NHT learning techniques of collaborative learning strategy. The problem of the study therefore is to investigate effectiveness of collaborative learning strategy in enhancing students' academic achievement in mathematics.

Purpose of the Study

The main purpose of this study is to investigate the effect of collaborative learning strategy on students' academic achievement in Mathematics. Specifically the study sought to,

1. determine the effect of Students' Team Achievement Division (STAD) learning technique on academic achievement of students in mathematics.
2. determine the effect of Jigsaw (JS) learning technique on students' academic achievement in mathematics.
3. determine the effect of Number Heads Together (NHT) learning technique on students' academic achievement in mathematics.
4. determine which of these learning techniques (STAD, JS, NHT) is most effective in enhancing students' academic achievement in mathematics.

Significance of the Study

The study will practically and theoretically be invaluable to the students, school counsellors, teachers, parents and the government. All stand to benefit from

the findings of the study. The strategy that could effectively help students improve their academic achievement in mathematics would be revealed.

Students would realize the importance of helping each other in the learning of mathematics. They would be encouraged to form groups where they set goals, model from each other, explain, elaborate, argue each others' points and solve mathematical problems together for better achievement. Also the students would no longer feel embarrassed or cheated if their mathematics teacher decides to introduce collaborative learning strategy in their mathematics lessons.They would come to realize that instead of loosing ,they would acquire knowledge above their developmental level and skills for future tackling of mathematical problems.

The outcome of the study further would enable school counselors to create awareness of the invaluable benefits of utilizing collaborative learning skills during individual and group counselling.These benefits include developing self confidence and interest in the subject, then having zeal to search for solutions to mathematical problems.

The findings would expose teachers to the learning strategy which if employed would enhance students' academic achievement in mathematics. Teachers would subsequently introduce group activities in their mathematics lessons to enable students be in full control of their learning activities while the teachers moderate.

Furthermore, the findings would be of interest to parents. They would see the importance of allowing their children to learn in small groups. This is because, through collaborative learning students not only learn more or deepen their

learning, they also develop skills like acceptance, patience, accommodation, respect, cooperation, problem solving among others. As a result parents would then be in a position to advice their children to be discussing their mathematical problems with other students in groups so as to gain knowledge and learn more approaches to solving complex problems. By so doing, their children must have acquired those mathematical skills that would facilitate their understanding of mathematics and be able to achieve better.

The government would also benefit from the result of the findings because they would see the need of training and retraining teachers in the application of collaborative learning strategy in mathematics lessons. The findings would serve as a guide to the government in the making of education policies concerning the teaching and learning of mathematics.

Finally, the findings of this research would serve as baseline data for further researches on how best to help students improve their academic achievement in mathematics.

Scope of the Study

This study investigated effect of collaborative learning strategy (STAD, JS, NHT) on secondary school students' academic achievement in mathematics. Specifically, the study was delimited to SS I students in co-educational secondary schools in Awka education zone that have professional Guidance Counsellors using two units of instructions from SS I second term mathematics scheme of work.

Research Questions

The following research questions guided the study:

1. What is the effect of Students' Team Achievement Division learning technique on academic achievement of students in mathematics?
2. What is the effect of Jigsaw learning technique on students' academic achievement in mathematics?
3. What is the effect of Number Heads Together learning technique on students' academic achievement in mathematics?
4. Which of these learning techniques (STAD, JS, NHT) is most effective on students' academic achievement in mathematics?

Hypotheses

The findings of the study were generalized by the following hypotheses tested at 0.05 level of significance.

1. There is no significant difference in the achievement mean scores of students exposed to STAD learning technique and those who received conventional counselling on academic achievement of students in mathematics.
2. There is no significant difference in the mean scores of students exposed to Jigsaw learning technique and those who received conventional counselling on academic achievement of students in mathematics.
3. There is no significant difference in the mean scores of students exposed to NHT learning technique and those who received conventional counselling on academic achievement of students in mathematics.

4. There is no significant difference in the mean scores of students exposed to STAD, JS and NHT learning techniques on students' academic achievement in mathematics.
5. There is no significant difference in the mean scores of students exposed to STAD and JS learning techniques on academic achievement of students in mathematics.
6. There is no significant difference in the mean scores of students exposed to STAD and NHT learning techniques on academic achievement of students in mathematics.
7. There is no significant difference in the mean scores of students exposed to Jigsaw and NHT learning techniques on academic achievement of students in mathematics.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presents a review of related literature on collaborative learning strategy. The review was presented under the following subheadings.

- **Conceptual Framework**
  - Concept of Academic Achievement
  - Concept of Collaborative Learning
  - Concept of Collaborative Learning Strategy
- **Theoretical Framework**
  - Behavioural Theory By Bandura
  - Social Interdependent Theory of Morton Deutsh
  - Cognitive development theory of Vygotsky
  - Cognitive elaboration theory of Dansereau, O'Donnel and Webb
- **Theoretical Studies**
  - Elements of Collaborative Learning
  - Categories of Collaborative Learning Strategy
  - Different Collaborative Learning Strategy
  - Values of Collaborative Learning Strategy
  - Challenges of Collaborative Learning Strategy
- **Empirical Studies**
  - Collaborative Learning
  - Students Team Achievement Division
  - Jigsaw
  - Number Heads Together
- **Summary of Review of Related Literature**

Conceptual Framework

Concept of Academic Achievement

Achievement has been defined as a task oriented behaviour that allows the individual's performance to be evaluated according to some internally or externally imposed criterion, that involves the individual in competing with others or that otherwise involves some standard of excellence (Sabir, 1990). Nwibe-Ezekoye (2008) also defined achievement as anything or something accomplished by intelligence, boldness or praise worthy exertion. Academics according to Hornby (2005) is something connected with education especially studying in a school environment. Academic achievement according to Annie, Stoker and Murray-Ward (1996) is an outcome of education, the extent to which a student, teacher or institution has achieved their academic goals. It is concerned with what someone can do at school, in classroom, laboratory, library or fieldwork. Academic achievement can be narrowed down to a subject. It is qualitative in nature; like, coming first in class, being able to publish a research work, being successful in examination or performing excellently well in a discipline.

In educational institution, success is measured by academic achievement or how well a student meets standards set out by the institution and external examination bodies. The standard has to be in comparison to ideal performance of others or the person's past performance. The academic achievement is measured through administration of tests, continuous assessment or

examinations. There must be a general agreement on how it is best tested or which aspect is most important (procedural knowledge such as skills or declarative knowledge such as facts). After every assessment or examination, grades or scores are awarded from which comparison or standard is established. Academic achievement may be high, average or low. It is low when a student's score is below 40% according to the Post Primary Schools Service Commission Awka 2011 promotion guidelines; and high when score is above 55%. Also 2011 WASSCE and NECO result analyses recognized C_6 and above (A_1- C_6) as high achievement. Therefore academic achievement in this context is knowledge attained or skills acquired or developed in mathematics usually by test scores or by marks assigned by teachers or both when compared with a standard.

Concept of Collaborative Learning

Collaborative Learning is the grouping of students in small groups for the purpose of learning. It is defined as an instructional design that stimulates peer interaction and learner to learner cooperation in the process of fostering successful learning by all (Killeen, 2007). Psychologists like Colbeck, Campbell and Bjorbell (2000), Johnson and Johnson (1998) Mitnik, Recaberren, Nussbaum and Soto (2009), Slavin (1995), Srinivas (2009), defined collaborative learning differently to suit the circumstances they wished to portray. However, they agree on one thing, "Learning together in a group." According to Sirinivas (2009), collaborative learning is an educational approach

to teaching and learning that involves groups of learners working together to solve a problem, complete a task or create a product. It is also regarded as the coming together of students, using variety practices in order to use course materials to answer questions or solve problems (Colbeck, Campbell, Bjorklund 2000). To Mitnik, Recaberren, Nussbaum, Soto (2009), collaborative learning is seen as methodologies and supportive environment in which learners engage in a common task where each individual depends on and is accountable for each other which include face to face conversation and computer discussion (online forum and Chatrooms). Collaborative learning in this context is simply the pairing or grouping of students for the purpose of learning.

Concept of Collaborative Learning Strategy

Collaborative learning is regarded as a mere relationship (Srinivas 2009), strategy, a set of systematic planned actions (Arriento, 2009), collaborative learning strategy therefore, may be referred to as different planned activities through which collaborative learning could be achieved. According to Pugach and Johnson (1995), collaborative learning strategy involves different ways two or more students, co-equals voluntarily bring their knowledge together in a group towards achieving a common goal.

In the words of Crooks (2000), collaborative learning strategy is effective learning approaches for the greatest number of students. The approaches include, Think Pair Share, Number Heads Together, Three-Steps Interview,

Students' Team Achievement Division, Jigsaw, Team Game Tournament among others. This study concentrated only on Students' Team Achievement Division (STAD), Jigsaw (JS), Number Heads' Together (NHT). Through collaborative learning strategy, peers empower each other to learn, work harder to help each other understand the material better, achieve team building, communication and problem solving skills thereby meeting many standards (Slavin, 1995). Collaborative learning strategy in this context therefore means innovative ideas, avenues, plans or techniques students apply during collaborative learning which enables them participate actively in enhancing their academic achievement.

Theoretical Framework

Some of the theories that can be used in explaining the key concepts in the study have been identified and discussed as follow

Behavioural Theory

Behavioural theory of collaborative learning was embedded in the theory of Albert Bandura in 1962. His theory focused on acquisition of learning through observation and vicarious experience. He theorized that people learn through observing others' behaviours, measuring and manipulating what was observed (Bandura 1962). That is to say, learning takes place through observing other people's behaviours, attitudes, and outcomes of those behaviours. The observed behaviours form ideas and images of how new behaviours could be

performed. The coded information serves as a guide for future action. To buttress his point, Bandura posited that learning would have been exceedingly laborious if people had to rely solely on the effects of their own action to inform them on what to do.

According to Bandura (1999) observation is governed by attention, retention, production and motivation, (four steps in observational learning).

Attention: Observation emphasizes on paying attention to the features of the modeled behaviour. Anything that distracts attention affects learning. Characteristics of both the observer, the person being observed and competing stimuli contribute greatly to the amount of attention to be recorded.

Retention: Ability to store information is an important factor in the learning process. For an individual to be influenced by observed behaviour, he should be able to pull up the information and act on it at one time or the other. Imagery and language aid in this process of retaining the information observed.

Reproduction: It involves symbolic representation of what was observed into appropriate action. Once one paid attention to the model and retained the information, he has to actually perform the behaviour. The learned behaviours need to be practiced for improvement and advancement of the skills.

Motivation: For the observational learning to be effective, the observer should be motivated to imitate the modeled behaviour. Reinforcement and punishment play important role in motivation.

Further Bandura (1977) explained that environment causes behaviour and that behaviour causes environment as well. He called this reciprocal determinism which was demonstrated in his early Bobo Doll studies. Bobo Doll according to Bandura is an egg shaped balloon creature with a weight in the bottom that makes it bobo pack up. Children's observation of different treatment metted to the Doll influenced their attitudes and behaviours. Johnson and Johnson (1999), Slavin (1995), observed that group provides incentives for members to take after others who are rewarded for their efforts. Students work hard on tasks that provide rewards and fail to work hard on tasks that provide no reward or punishment. Therefore, vicarious experience enables individuals to learn novel behaviour without undergoing a trail and error process of performing it (Woolfolk, 2004). In most cases keep them from risking costly and potentially fatal mistakes (Bandura, 1995).

Similarly in collaborative learning strategy students observe each other in their groups, imitate and model others' behaviour with a view to learning and achieving more in mathematics, just as theorized by Bandura. If the model is interesting and novel, members pay attention, which may result in learning different and easy approaches to problem solving; as such facilitate storing, retaining, and remembering what one has paid attention to. The encoded behaviour may be translated into imagery and verbal description to be reproduced or transferred later. Group members learn from what happened to other members. Reward/remuneration or punishment metted to a member in the

group or success incurred in solving mathematical problems will either motivate other members to achieve higher or dissuade them from repeating the same behaviour.

Social Interdependence Theory

Social interdependence theory is found in the early studies of Morton Deutsch in 1962. Deutsch addressed the problem of inability of schools to provide students with necessary opportunities to constructively interact with each other in the classroom. He integrated the ideas of social interdependence as it affects group interactions. The theory assumed that cooperative efforts among classmates exist to the point that there is an intrinsic motivation within the members and that all members desire to reach a common goal. Social interdependence according to Deutsch (1962) helps to demonstrate that cooperation may be used to involve students actively in learning situations and to achieve educational goals simultaneously while accommodating individual differences and at the same time addressing variety of social problems.

Two types of interdependence were conceptualized by Deutsch (1962); Positive and negative interdependence. To him, positive interdependence exists when there is positive correlation among individuals' goal attainment. Individuals perceive that members can attain their goals if and only if the other individuals with whom they are cooperatively linked attain their goals. It results in promotive interaction (individuals encouraging and facilitating each other's

effort to complete tasks in order to reach the group's goals). Negative interdependence exists where there is a negative correlation among individuals' goal achievement. Individuals perceive they can obtain their goals if and only if the other individuals with whom they are competitively linked fail to obtain their goals. Negative interdependence results in oppositional interaction (individuals discouraging and obstructing each other's efforts to complete tasks in order to reach their goals). Deutsch emphasis is on positive interdependence which will result in promotive interaction as the members encourage and ease each other's effort to learn. Students will be willing to help each other because they care very much about one another and want each other to succeed. The mere knowledge that members are depending on one another to succeed is a powerful motivation for a group work (Slavin, 1996).

Kurt Lewin (1948) proposed that the essence of a group is the interdependence among members that results in the group being a dynamic whole; so that a change in the state of any member or subgroup changes that state of any other member or subgroup. Group members are made interdependence through common goals. As members perceive their common goals, a state of tension arises that motivate movement toward the accomplishment of goals.

In the same vein, Johnson and Johnson (1999) contributed that the way social interdependence is structured determines individual rate of interaction in the group. To them positive interdependence is an ingredient for group survival.

Johnson and Johnson spelt out factors that facilitate group interdependence which include; specifying group goals and rewards, group division of labour, accommodating each other's contributions and periodical evaluation. Success and failure of a group may be attributed also to the group cohesiveness and team spirit. To Bean (2001) these attributes will be evident if members are sensitized adequately on what they will gain from the group.

Since social interdependence is advocating group life wire, it is then deep rooted in collaborative learning. The success of collaborative learning activities depends on the rate of participation among members; that is the willingness of members to work for each other's growth. Collaborative learning strategy therefore promote mutual linking, better communication, higher acceptance and support which is inbuilt in the positive interdependence of Morton Deutsh.

Cognitive Theory

Cognitive theory of collaborative learning strategy discussed under two headings; Cognitive Developmental theory and Cognitive Elaboration theory.

Cognitive Development Theory

Lee Vygotsky, one of the proponents of Cognitive development theory theorized in 1978 that man learns through social interaction with others; and that knowledge construction is a cooperative venture. He stressed on the foundation role of social interaction in the development of cognition and

behaviour. The only good learning he emphasized is that which is advanced, or above the developmental level of the child.

He developed two principles of learning known as More Knowledgeable Other (MKO) and Zone of Proximal Development (ZPD). More Knowledgeable Other is referred to as someone who has better understanding or of a higher ability level than the learner with respect to a particular task, process or concept. The MKO may be a teacher, an adult, peers or electronic support; from which/whom the student will obtain information.

Similar to MKO is the Zone of Proximal Development; Vygotsky (1978) described ZPD as the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. That is a situation by which a more capable person guides, assists or encourages a less capable person to understand ideas beyond his level of development. When a student is faced with difficult problem, he approaches a more capable/skilled person (adult/peer) for assistance. Therefore, during group sessions, because students in the groups are of different intellectual levels, they worked on the given exercises. Those who understood the problem better helped others in the group to learn better. They also explained/shared easier methods to arrive at the solution to their problems. By so doing students understood more and even developed above their intellectual level.

For instance, a child could not solve a problem by himself and would have taken a longer time (if at all) but was able to solve it following interaction with a more skilled person. The child had not only learnt the material but has also developed competence and skills that will be applied to future problem/task. Vygotsky sees Zone of Proximal Development as the area where the most sensitive instructional guidance should be given. That is allowing the child to develop skills they will use on their own by so doing developing higher mental functions. Also to Vygolsky, peer interaction is the most effective way of developing skills and strategies for tackling immediate and future problems.

Therefore just as Vygotsky has it, collaborative learning strategy advocates that exploration should permeat the arena of learning and participation should be an expected learning culture. Slavin (1990) opined that the struggle to solve cognitive conflict during collaborative learning activities results in development of high level understanding. In integrating Vygotsky's theory into peer collaboration, Damon (1984) proposed a theoretical model where he explained how collaborative learning strategy could help students' achievement which runs thus; collaborative learning strategy:

- exposes inadequate or inappropriate reasoning, which results in disequilibrium that can lead to better understanding.
- motivates individuals to abandon misconcepts and search for more powerful concepts.
- provides a forum that encourages critical thinking.

- Leads to constructive controversy which focuses student's thinking and increases the use of higher order cognitive process.
- encourages students to vocalize ideas, which inevitably improves their performance.

Vygotsky's theory is very much in line with what is obtainable in collaborative learning strategy. Students in collaborative learning strategy groups are of different ability level and culture. They interact with each other with a view to solving their mathematical problems. There may be problems beyond the capabilities of some members, the more knowledgeable other in the group will teach the rest. The exchange of ideas introduces high thinking order which will enable the students to understand, learn and retain better.

Cognitive Elaboration Theory

The theory was propounded by Dansereau and his colleagues, O'Donnel and Webb in 1988 at Texas Christian University after series of research works using 'cooperative scripts.' They theorized that information processing process such as encoding, schema activation, rehearsal, metacognition, retrieval performed in the presence of peers result in deeper learning and motivation. The presence of peers can help students stay on task, and the feedback provided by peers can help the students observe when there is need to check their understanding of the context they are trying to explain.

Elaboration to them involves adding details, giving examples, generating images and in general relating new material to what is already known. The

person elaborating/recaller summarizes the information; while the listener corrects any errors, fills in any omitted material, helps to think out ways that both students (recaller/listener) can remember the main ideas. These elaborations are incorporated into learners existing knowledge and as a consequence, their mental representation are reorganized and increased thus in a complex form, thereby improving understanding and recall (Dansereau, 1988, Webb & Favivar, 1994). Elaboration theory maintained that if information is to be retained in memory and related to information already in the memory, the learner must engage in some sort of cognitive restructuring. It emphasized that one of the effective ways of elaboration is by explaining the material to someone else. Explanation to others challenges the explainer to generate new relations and form new perspectives. The person explaining the material might detect the gaps in his own knowledge and use the explanation to fill in these gaps.

Researchers, (Van , Vander & Kanselaar, 2000), have shown that the frequency of elaborative explanation during small group discussion correlates positively with learning achievement. They went further to observe that explaining, questioning and other elaborative activities are likely to occur in group learning because they are triggered by others during interaction. Wittrock (1992) noted that collaboration can stimulate elaboration because students process information more deeply when they interact with each other. To Wittrock, elaboration can be seen as the generation of meaningful new relations

between prior knowledge and new information. In the words of Hamiliton (2004) elaboration leads to an enriched knowledge base with more interconnections. Inside this enriched knowledge base, information should be retained.

Furthermore, Webb (1992) observed that people who gain most from cooperative activities are those who provide elaboration to others. In the same way Dansereau (1992) pointed out that students who receive elaboration learn more than those who worked alone but not as those who elaborate to others. Gaves (1983), Hillocks (1984) applied cognitive elaboration in their writing process model where peers worked in response groups or formed partnership to help one another draft, revise and edit composition. Such models have been found to be effective in improving creative writings and a writing process model. Stevens, Madden, Slavin and Farnish (1987) observed that the programme helped in increasing students' writing achievement. The idea behind their using peer response groups is that if students learn to evaluate other's writings, they will become better writers themselves.

Elaboration theory therefore is very much adapted to collaborative learning strategy setting where students are expected to come together in groups or pairs, exchange ideas, recall information from text material, summarizing, solving mathematical problems, detecting errors and omissions, explaining and asking questions thereby helping each other to learn. The idea of helping one another to learn implies that they will not only teach but explain the material

fully in such a way that all will understand. In the explaining, the individual explaining will come to know more, retain more and shave off wrong information already stored.

Theoretical Studies

The researcher looked at peoples' opinion concerning collaborative learning strategy with a view to explaining more on the concept. This is done under some subheadings.

Elements of Collaborative Learning

Looking at collaborative learning as a relationship, Totton, Sills, Pigby and Russ (1991) suggested that effective learning will occur under condusive atmosphere that includes five elements. Johnson, Johnson and Holubec (1998) spelt out the elements as positive interdependence, face to face promotive interaction, individual accountability, appropriate use of collaborative skills and group processing.

- **Positive Interdependence**

Positive interdependence means that a gain for one student is associated with the gains for the other students (Johnson & Johnson 1995). It depicts that students must depend on each other to succeed, and members should work together to accomplish something beyond individual success. Members are expected to engage in a team building activities which encourages give and take and to realize that in their group as well as in actual life, each can do something,

but none can do everything. Students need to participate in activities which they learn to depend on each other for the accomplishment of a goal.

Positive interdependence is widely endorsed as an approach that promotes learning and socialization among students (Gillies, 2007). Also Williams (2007) maintained that positive interdependence is very essential for the success of any group. Team work fostered by positive interdependence among members, helps students to learn interpersonal skills that would benefit them socially and vocationally. Students need to be linked with others in a way that ensures that all succeed together (Johnson, Johnson & Smith, 1995).

Face to Face Promotive Interaction

It is a simultaneous interaction where members come together to complete assignments and promote each other's success by encouraging, praising, supporting, helping and assisting each other. This element was explained by McGoarty (1993) as interactive tasks that naturally stimulate and develop students' cognitive, linguistic and social abilities and create powerful learning opportunities. Oral interaction is emphasized too. Members provide one another with feedback thereby challenging one another's perspective. Every member of the group has equal right, freedom and opportunity to contribute and participate in explanation, discussion, decision taking and evaluation of the group activities (Slavin, 1995). In discussing face to face interaction, Moran and Steiner (2003) posited that knowledge is seen as a constructive Venture among members.

- **Individual Accountability**

Members in a group are held responsible for doing their work or mastering of the material to be learnt (Johnson, Johnson & Smith, 1991). Accountability according to Williams (2007) is necessary for three things, being active and engaged in group activity, doing a fair share of the work and helping each other to demonstrate competence and learning achievement. No one individual is allowed to dominate the group either socially or academically.

Accountability exists when performance of each individual member is accessed, the result given back to the individual and the group compared against a standard of performance and the member is held responsible by group members for contributing his or her fair share to the group success (Slavin, 1995). Not only is each member's performance accessed individually, the evaluation goes to the entire group. Each member is aware of who needs what kind of help.

- **Appropriate use of Collaborative Skills**

For collaborative learning to be effective, a number of skills must apply. This is because simply placing students in groups telling them to be or work as a team does not assure that they would comply. Team work skills have to be taught to the students. Members of a group should be encouraged and helped to develop, model and practice, trust building, leadership, decision making, communication, elaboration and conflict resolution/management skills (Slavin, 1996).

- **Group Processing**

According to Johnson, James and Mcdonald (2000), students individually or collectively need to evaluate their process effectiveness continually. This can be done by asking questions like, what did each member contribute that helped the group? What can each member do to help the group grow? Which approach was appropriate and successful? Which approach should be dropped or modified?

These elements evident in group activities during mathematics lesson enabled the groups to be functional, participate actively, be interested and enjoy the subject.

Types of Collaborative Learning

According to Cross (2002), collaborative learning is grouped into three; formal, informal and group based collaborative learning.

- **Formal Learning Group**

Formal collaborative learning groups are established, facilitated and monitored to complete a specific task (Williams, 2009). The task may be in form of Jigsaw, assignment, project, any course material, laboratory work/experiment or writing of report. The group may consist of two to five members and may complete their task in a single class session or several weeks.

Typically, students work together till they finish the work at hand. The group assignment ceases as far as the task is completed.

- **Informal Collaborative Learning Group**

Informal collaborative learning groups are adhoc, temporal clustering of students within a lesson to facilitate understanding of the topic at hand (William, 2009). The group is mainly made up of two students, latest, three at a time. It can be changed up to two or three times during the lesson. Such as, Think Pair Share, Number Heads Together among others. Informal collaborative learning is used to draw students attention to the lesson and keep them at alert and elicit full participation. Teachers use informal collaborative learning group to check immediate understanding of the topic by members. Copper (1990) contended that the grouping provides opportunity for students to apply their knowledge or to provide change to pace. The grouping also enables students to process, consolidate and retain more information learned.

- **Group Based/Study Team**

The group based has a stable membership and long term characteristics. The membership can last for years or as far as the course requirement and assessment (Johnson and Johnson, 2000). The group aims at contributing to one another's knowledge, mastery of a topic by regular discussion of the material, encouraging one another and supporting the academic and personal success of group members. Group based is very prominent in study groups.

Different Techniques in Collaborative Learning Strategy

Collaborative learning strategy cover broad territory of approaches with wide variability in the amount of in-class and out class time built around group work. Collaborative activities range from discussion, intersperse with short lectures, through the entire class periods, to study in research teams that may last for a whole term or year. The choice of collaborative learning activities depends on the nature of the topic at hands, the goals and process. Johnson and Johnson, (2002) posited that students' tasks involved creating a clearly delineated product, participating in a process, an exercise of responding to each other's words and engaging in analysis of meaning making. Some of these learning techniques will be discussed thus:

- **Think-Pair-Share/Pair Problem Solving (TPS)**

Think-Pair-Share was developed by Frank Lyman of University of Maryland in 1981. It is a four step discussion strategy with relatively low risk and short collaborative learning process. TPS is well suited for instructors who are new to collaborative learning. In using TPS, the instructor poses open ended and challenging question and give one minute to think about the question. The learners turn to their neighbours to discuss the issue/question for three to five minutes. The first step is the 'think-time' and might be spent in writing, thinking, solving mathematical problems. The response might be shared with a four-person learning team within a large group. The instructor then calls for comments to be shared with the whole group (Slavin, 1995). The response

received is more intellectually concise since learners have had chance to reflect on the ideas. One variation is to skip the whole group discussion and introduce a quiz. Another variation is to have learners write down their thoughts on note cards and collect them. This gives the instructor opportunity to see whether there is any problem in comprehension and enables him to assess students individually (Johnson, 2003).

TPS enhances communication skills. High caliber of discussion is enhanced by this technique and all students have the opportunity to learn by participating, reflecting, verbalizing, practicing, sharing and receiving potential solutions. It enables members to discuss their ideas, construct their own knowledge and find out what they do or do not know (assessing their level of comprehension of the topic). Lyman (1981) summarized this strategy by stating that students and teachers learn to LISTEN while, questions are being asked. THINK without raising hands to response. PAIR with a neighbour to discuss response and SHARE their response with the whole class. Time limits and transaction cues help discussion move smoothly.

In the same vein, TPS is a warm up of a whole class discussion. The think component gives students opportunity to reflect on prompts, collect and organize thought. The ‘pair’ and ‘share’ components allow students to compare and contrast their ideas with a peer and rehearse their response first in a low risk situation before going to public with the whole class (Barkley, Cross & Major, 2006).

- **Number Heads Together (NHT)**

Number Heads Together is a collaborative learning technique by which the students put Heads together in solving problems at hand. It was developed by Russ Frank in 1990. Ibraheem (2011) contented that group members are usually four. The students in each team are numbered 1,2,3,4. The instructor poses a high order question. Students are expected to coach each other in their groups on the materials to be mastered assuring that every group is aware of the answer agreed upon. The instructor can call on any number to answer a question. Members with that number answer and earn a point for their group. This may be done with only one student responding (sequential form) or with all the numbers 4s for instance responding using an Every Pupil Response Technique (EPRT).

Since none knows which number the teacher would call, all team members have vested interest in understanding the appropriate response. It is assumed that no person is aware who the representative of the group will be. NHT is useful in reviewing objective material in a fun way. Students benefit from the verbalization and the peer coaching helps both the high and low achievers. Class time is better spent because less time is wasted on inappropriate response. All students are in active participation during discussions. Slavin (1995) says that NHT is an excellent way of ensuring individual accountability in a group discussion. To Iqabl (2004), it is a sure way of ensuring total involvement of all the members.

Steps in applying NHT (Ibraheem, 2011)

- Number off the students 1 - 4 in each group. If one group is smaller, the others having numbers 3 will answer no. 4 as well. The teacher can give numbers or students can give numbers themselves.
- Teacher asks the students questions on sets of problem to solve. It must be stressed that everyone in the group must be able to participate and answer the question.
- Ensure enough time is given for the group to do the task.
- There is expectation that everyone in the group will be able to answer the question following the discussion. "Make sure you…." There are many other ways of ensuring the teacher cues the students into the collaborative activity.
- The "students put their heads together" in order to solve the problem and also ensure that everyone in the group can answer the question.
- Question is asked, a number called, only students with that number should contribute.
    - If students could not answer readily then, more time would be given for mastery. NHT is very important in student's learning because every member of the class is involved in discussion and mathematical problem solving. It increases individual accountability and group teaching. Every member of the group is preparing each other to defend the group when called up. Also team spirit and satisfaction is assured.

- **Three –Step Interview (TSI)**

In using TSI students are assigned roles and they play roles themselves. The instructor gives assignment or poses a question that will be researched on,

1. ‘A’ interviews ‘B’ for a specific number of minutes listening attentively and asking probing questions on how he was able to solve the problem and the procedure used.
2. At a signal, the students reverse roles and ‘B’ interviews ‘A’ for the same number of minutes.
3. At another signal each pair turns to another pair forming a group of four. Each member of the group introduces his or her partner, highlighting most interesting points.

TSI is useful in sharing information. It is used as an ice breaker for team members to get to know each other and get acquainted with the concepts [in depth] by assigning roles to students. Iqable (2004) has it that the team structure can be used as a team builder for opinion questions, predicting, evaluating, sharing book reports.

- **Round Table Structure (RTS)**

Round table structure may be used in brainstorming, reviewing and practicing, at the same time serving as team building. Also, is used in generating large number responses to a single question or group of questions. The instructor asks a question which has multiple answers. One piece of paper

and a pen is given to each group. Students take turns writing the answer on the paper, passing the paper and pen clock wise to the next person.

The process is, the first student writes response and say it laud. He passes the paper to the left, the second student writes his response and it continues round the group till time is up. Each member says 'pass' at any time. Each group is expected to stop when time is up. The essential thing is that the question can generate several answers. It must be related to the topic and relatively simple for all to attempt. When time is up, it is the duty of the instructor to determine what to do with the list immediately-discussing the multiple answers or share the response lists with the entire class (Iqable, 2004).

- **Send A Problem (SAP)**

Send a problem may be used as a way to get members of a group to discuss and review material and provide potential solutions to a problem relating to the content. The procedure runs thus, each member generates a problem and writes it down on a card. The question is thrown to every member of the group. If the members are able to answer the question, the answer will be written at the back of the card. If not the question is recast to enable members to contribute effectively. The group now writes the question on one side of the card and the answer on the other side. Each group then sends its question to another group.

Each group takes one question from the stack of questions and reads one question at a time. After reading out, the group discusses it. If the group agrees

with an answer, the members now turn the card to see if it agrees with the first group's, if it coincides, then they proceed to the next question. If not, the group writes their answer on the other side of the card as an alternative answer. The second group might be sent to the third, fourth or fifth groups as the case may be. When the question cards must have gone round, the stack of questions might be sent back to the first group which may discuss the question on the cards or clarify some issues.

SAP is used in getting the group to discuss real problems where there is no set question. It is more profitable if each group picks different question. The group discusses and passes to more than one or two groups. Then the last group reviews all the solution suggested by other groups and develop prioritized list of possible solutions. The solution list is then presented to the entire class (Anya, 2006).

- **Focus Listing (FL)**

This is another brainstorming techniques that can generate description and definition of concepts. In FL, the instructor asks a question to generate multiple words to define and describe something. Once students have completed the activity, they can use the list to facilitate group discussion. For instance, the students might be asked to list six or eight words or phrases that describe or define what a motivated student can do from this, the students will be shared in groups for discussion. This technique can be combined with other

techniques for effective collaborative structure (Chianso, Kurume & Okpara, 2008).

- **One Minute Papers (OMP)**

This method can be used for lesson introduction and provision of feedback on the students understanding of the previous lesson. The students are shared in groups and asked to list what they understood from the previous lesson within two minutes. They may be asked also to mention the difficulties or conflicts they encountered during the lesson.

- **Peer Teaching (PT)**

Peer teaching according to Whiteman (1986), is the oldest form of collaborative learning strategy in American Education. He introduced three types of peer Tutoring.

1. Supplementary Instruction (SI) is an undergraduate model developed by Deanna Martin at the University of Missouri- Kansas city adopted by hundreds of colleges in the United states. It recognized the need to offer help to fellow students Supplementary instruction is targeted at "risk classes", where 30% of the students either fail or withdraw from school. The university authority invites an advanced undergraduate who have done well to become SI leaders. These students are paid to convene instructions in these classes for at least three times a week. In each case,

peer tutoring includes students teaching each other in their various groups. They assume roles and the role rehearses.

2. Writing Fellows (WF) "bottom Up Approach' This method is introduced by Haring Smith in 1987 at Brown University. It is used to sustain writing across the curriculum activities. W.F buttresses Vygotsky's theory of more knowledgeable other and zone of Proximal Development.

3. Mathematical Workshop (MW)

This is a peer tutoring approach that spread rapidly throughout 1980's which is developed by Uri Treisman at the University of California, Berkeley. It is an intensive mathematics programme. Treisman (1985) found that study groups made a difference in students academic success, created a co-peer tutoring approach called the Professional Development Programme. This workshop supplemented the lecture discussion sections of mathematics courses. Its emphasis is on developing strengths rather than remediating weakness and peer collaboration rather than competition. After short instruction from the teacher, the students now retire in their various groups to digest the material and help each other to understand it more.

- **Discussion Groups And Seminars (DGAS)**

DGAS was founded by Christ Garvin and Sweet in 1991 where emphasis is on open ended discussion and seminars which put the onus on the teacher or

student to pose questions and build effective conversation in the context /the topic. There is enormous variability on who sets the agenda, who recognizes or monitors the discussion and who evaluates what. The discussion is heavily student – student centred with the teacher serving as mediator for clarification and keeping the students on track.

- **Project Group (PG)**

The teacher or group leader must ensure that all participated in the project. A member is not allowed to dominate the project while others free-ride. To get members to participate effectively the project is shared into parts and each part assigned to specific member. Finally, they collect and present. Slavin (1995) suggested that if group members are not comfortable with an individual responsibility for the group product, they are unlikely to participate fully.

- **Pair Checks (PC)**

This is a way of pair checking or mastering oriented worksheets. Students work in team of four with two sets of partners. The worksheet is set up with problem presented in pairs. The first person in each partnership does the first problem with the pair serving as coach and offering exaggerated praise. After the first problem is done, partners change roles. After each pair of problems, team of four check each others work and if they agree, give a team cheer or handshake. In this way students stay on track, working together towards mastery (Kagan, 1995).

- **Cooperative Review (CR)**

Cooperative Review is most appropriate during revision. A day to the examination, the group make up review questions. They take turns asking each other in group. The group asking the question gets a point while the responding group score points for any correct answer. Then another group may be required to add more information to the answer. If they succeed in doing so, that earns them their group score. In another version of CR the teacher brings in the questions the groups will answer. In another variation, the teacher or student poses a question, the team/group members would be allowed to discuss the answer within the group. After this brief, Number Heads Together time follows, a number is called 1,2,3,4, students with the corresponding number to come up with the right answer. Another number may be called and another member bearing the number comes up to add more information and earn score for his group. If the teacher feels that another information is needed he can call on the third number and so on (Ibraheem, 2011).

- **Jigsaw**

Jigsaw is a collaborative learning technique developed by Elliot Aranson and his students at the University of Texas and Califonia in 1975. Jigsaw according to Slavin (1995) is a technique that divides a lesson topic into different parts and each student is supposed to be an expert in one piece. As a result all must depend on each other to learn or understand the whole material. The principle of this method has it that each piece and each student's part' is

essential for the completion and full understanding of the final product. If each student's part is essential then each student is essential in the group and that is precisely what makes Jigsaw very effective.

In Jigsaw, students work collaboratively in two different groups, their original and expert groups. Grades are based on Individual examination. Jigsaw divides the lesson topic according to the number of students in each group. The members aspire to learn their aspect of the material. Incidentally each member is expected to learn all aspects of the material to succeed. Students leave their original group to form expert groups in which all persons with the same piece of information come together to study. Eventually each student goes back to his original group to teach and help the rest of the members to learn and understand the material.

The situation is so organized that the only access each member has to others information concerning the rest of the segments of the topic is by listening carefully; asking questions and contributing where necessary while members are reporting. So if any one ignores or fails to participate while others are reporting, he may not perform well in the individual quiz that follows. To increase the authenticity of the report, the students do not go straight to report to the mother group, rather, they learn and rehearse how to present or teach the material to others in the expert group. Jigsaw is particularly useful for students who might have initial difficulty of learning or organizing their part of the assignment. It allows them to hear and relate with other experts. When they

convene in their original group, the expert students should teach the rest of the group. In this structure each member is assigned an essential part to play.

Jigsaw encourages listening, engagement and empathy. Group members must work in team to accomplish a common goal each depending on all others to achieve (Shalqat, 2008). This collaborative design facilitates interaction among Students in the class enabling them to value each other as contributors of their common task.

Student Team Achievement Division (STAD)

Student Team Achievement Division was developed by Robert Slavin in 1986. It has been described as the simplest of all the collaborative learning methods (Armstrong, 1998). STAD is a collaborative learning technique whereby students are shared into heterogeneous groups of not more than five (gender, ethnic group, different levels of achievement among others). The teacher introduces a new lesson through lecture, debate, discussion, allows group members some minutes to collaborate on work sheet designed to expand and reinforce the material taught. Team members have options of either,

a. Work on the work sheet in pairs,

b. Take turns quizzing each other,

c. Discuss problems as a group or

d. Make use of all available resources to learn the assigned topic.

Students' activities involve, problem solving, discussion, comparing answers and correcting misconceptions if any. The team task is not complete till every member of the team masters the assigned material.

Following the group discussion is the individual quizzes where none is allowed to help the other. The quizzes are graded individually then the scores added to the group. The team provides the peer support for academic performance that is important for learning, STAD affords the students the opportunity for mutual concern and respect, inter group relations, self esteem and acceptance of mainstreamed students (Iqabel, 2004). To Ibraheem (2011), STAD is relatively easy for teachers and most successful in increasing students achievement.

Steps in Applying STAD (Ibraheem, 2011)

- Present the topic in form of lecture demonstration and discussion.
- Students in five member heterogeneous teams within the group engage themselves in intensive cooperative study of the learnt material, by studying worksheets, performing experiments, checking and drilling each other.
- Each student in all the teams should be given a worksheet to be submitted in order to assess each student's contribution to the team's effort.
- Students may be asked question in form of quiz.
- They work in teams to provide answers to the question.
- Best three teams are recommended.

- Students copy down their home assignments.
- Students' quiz scores are compared to their own past average and points are awarded on the basis of the degree to which students meet or exceed their own earlier performance. These are summed to get team scores, the team that meet certain criteria may be rewarded with certificate.

- **Team Game Tournament (TGT)**

Team Game Tournament is like the STAD, it only replaces quizzes with weekly game tournaments (academic games) students play as representatives of their groups in order to contribute points for their groups. They compete with students having the same achievement level and coach each other prior to the games to ensure all group members are competent in the subject matter. TGT was originally developed by David Derives and Keith Edwards at the University of John Hopkings as a cooperative method. (Deveries; Mascom& Shacjman, 1975).

Students play games at three person tournament tables with others having similar past records in mathematics. A 'bumping' procedure keeps the game fair. The top score at each tournament table brings sixty points to his team regardless of which table it is, this means that all has equal opportunities to succeed.

- **Values of Collaborative Learning Strategy**

Collaborative learning strategy if strongly built on the five elements mentioned above can be very exciting for students because it makes them

actively engaged and committed to their studies (Nwankwo, 2006). Collaborative learning also may be regarded as a valuable strategy for helping students attain high academic standards. Some of the benefits of collaborative learning strategy are; promoting deep learning, students achieving better grades, learning social skills and civic values, increase of high order thinking skills, promoting personal growth and development of positive attitudes towards autonomous learning(Aldrich, 2010). Other values of collaborative learning include:

* **Enhancing academic achievement of low achieving students**.

The level of interaction that exists during collaborative learning enables students to cooperate and help each other to learn better. It is expectd that low achieving students would learn from high achieving students thereby improving their performance (Arends 2006). Cohen (1994) also contended that low achieving students benefit a lot when grouped with high achieving students. The improved performance was attributed to one to one tutorial existing in collaborative learning. This opinion was supported by Burns (1990) who stressed that low achieving students in collaborative learning classroom do not lack assistance. Assistance is at their beck and call. Williams (2000) posited that weaker students are afforded opportunity to use model reasoning process from academic stronger students. And that group members prepare each other for test and get each other ready for examination. This assistance is obvious in

group setting because members are conscious of their group grade as well as individuals.

From the above testimonies one may ask, does collaborative learning favour only low achieving students? Nwankwo (2006), Soller, Goodman, Linton and Gaimari (2012) answered that high achieving students gain also by learning social, democratic and other collaborative skills and even deepen their understanding of the material. Furthermore, Johnson and Johnson (2000) contended that constant brainstorming and elaboration enable the students both high and low achievers to get frequent feedback from their group members.

* **Collaborative learning promotes critical thinking**

Collaborative learning strategies engage students in multiple tasks that promote high level thinking (Johnson & Johnson, 2002). It keeps the members very much engaged cognitively. Students set goals within the framework of what is being taught, provide options for activities, get involved with assignments that capture different students' interests and goals and encourage them to access what they learn (Tinzman 1991). When asking and answering questions are going on, students are developing valuable problem solving skills. Furthermore, Maznah (2004) observed that collaborative learning activities involves students in research that enables them expand and stretch their creativity or think out innovative ideas. Slavin (1992) elaborated on this by contending that when students are discussing the content / material, cognitive reasoning arises and inadequate reasoning emerges. It was on this note that

Williams (2000) commented that the exercise helps in the development of metacognitive skills of learning. They monitor their progress and comprehension of the content /material detecting errors and how to make corrections and suggesting ways of improvement.

* **It Improves students attitudes towards school and the subject taught**

Activities inherent in collaborative learning maximize students interest towards school and attendance to classes. During collaborative lessons, the students contributions are valued, solicited, respected and celebrated. These instigate commitment, and positive attitude towards school and the particular subject. Also it changes students attritions towards poor performance from not being intelligent enough to not having tried enough (Slavin 1995).

* **Collaborative learning breeds self confidence**

Students wean themselves away from the notion that teachers are sole source of knowledge and understanding (Webb, 1986). Students are encouraged to take responsibility of their goals, reach out for more authentic information from- books, internet and their fellow students. They bring in their own perspectives and try out that of others with the view to understanding the material (Webb 1986). Students are encouraged to take responsibility of their goals, reach out for more authentic information from books, internet and their fellow students. They bring in their own perspective and try out that of others with the view to understanding the material more and even learn different approaches to problem solving. Students are linked up with other students who

can help them become knowers as well as learners in a supportive environment. These rigours which students undergo in their learning enable them own their learning and be more convinced and have self confidence.

* **Development of interpersonal relationship**

One outstanding benefit of collaborative learning is that it creates better understanding, accommodation, trust and likeness among members regardless their culture, ethnic group, gender, ability or socio-eonomic level (Williams, 2000). Studies carried out by Brown and Cuiffete (2009) confirmed that collaborative learning is cross cultural. It was equally reported that students who participate fully in collaborative learning activities exhibit collaborative behaviours (Brady & Isay, 2010).

- **Collaborative learning encourages shared learning**

The metaphor of collaborative learning according to Tinzman et al (1990) is shared knowledge. The teacher has vital knowledge and information about the subject, but he still builds upon the knowledge and personal experiences, language, strategies and culture that students bring to the learning situation (Johnson et al, 2000). When opportunity is allowed for sharing, the class is enriched. Panitz (1993) observed that when students see that their knowledge and experiences are valued, they are motivated to listen, participate fully and be in a position to connect their learning experiences with the school learning thereby improving their performance. Students go awide to collect information from books, journals, peers, internet, and even from their teachers. They are not

satisfied till the information collected is shared among members, debated, discussed and valued.

Students also give and receive help from group members. The giving and receiving help require the giver to clarify and reorganizes his understanding, facilitate his retention and retrieval. Receiving help may fill in gaps in the receivers' understanding (Nwankwo, 2006) or help them clarify misconceptions. Williams (2007) reiterated that receiving help from peers increases the quality of feedback available.

There was an observation by Robertson, Davidson and Dees (1999) that collaborative learning strategy could be integrated at any level in the teaching of mathematics and for any mathematical topics. They observed that collaborative learning strategy was the most enjoyable method for both teachers and students in the teaching of mathematics. Students learn to cooperate with others and communicate in the language of mathematics. It offered more opportunity for students to ask question in a relaxed atmosphere, solve problems, create solutions and work conveniently with other peers.

Researchers (Brown & Cuiffeteli (2009); Srinivas (2009) are of the opinion that collaborative learning strategy promotes students' positive attitudes towards the subject matter, create environment for activeness, involvement, commitment and exploratory learning. It enables students to use team approach to problem solving yet maintaining individual accountability. Hence, Srinivas

(2009) concluded that collaborative learning is effective for every ability level and enhances students' perception of one another.

Davidson in Iqabl (2004) pointed out the benefits of cooperative learning in the study of mathematics.

- Mathematics problems can often be solved by the use of different approaches.
- Students in groups can discuss the merits of different proposed solutions and perhaps learn several strategies for solving the same problem.
- Students in cooperative learning classroom can help each other to master basic facts and necessary computational procedures. This is possible through different approaches like games, puzzles or discussion of meaningful problems.
- It provides social support mechanism for the learning of mathematics and an opportunity for success for all students in mathematics.

In the same way, Johnson and Johnson (1990) outlined the following attitudinal objectives of collaborative learning strategy in Mathematics.

- Developing confidence in one's ability to reason mathematically.
- Willingness to try various strategies and risk being wrong.
- Ability to accept frustration that comes from not knowing and willingness to persevere when constructive solutions are immediate.
- Ability to make wise attributions, that is attributing ones failures to haven not been able to come up with right strategies yet, rather than

not being competent. Johnson and Johnson also agreed with Davidson (1990) when he said that one's confidence to reason mathematically is considered prerequisite for learning mathematics. Once lost, it is difficult to restore.

Challenges of Collaborative Learning Strategy

Despite the above documented benefits of collaborative learning strategy, Lisa (2009) observed that the strategy is still dreaded and avoided by students. This may be looked at from the perspective that the original education handed over to us is individualistic and competitive in nature. Akinbola (2006) posited that most of the cooperative activities are regarded as cheating. Students were instructed to mind their papers' do their home work' do not ask or receive any help from any person during examination. According to Kolawole (2008) students are concerned only with their individual grades, the mark –margin with which they are surpassing their mates and noting where they fit into the grade curve. None of them thinks of helping others to achieve better. The only cooperative activities encouraged in school take place during extracurricular activities, since students are ignorant of collaboration and collaborative skills in learning, its initial introduction in class may be daunting for some reasons; concern for wasting time, handling of slackers' (none productive members of the group) and grading or evaluating of group activities (Anis, Mahari, Latisha, Asinoak & Surina ,2009)

Slavin (1995) also pointed out that the brilliant students are not comfortable with the strategy. They feel that they waste their time teaching the dull ones that when assignment is given to the group, they are expected to do the whole work while others hitchhike. Low achieving students in the group may feel that their ignorance is being exposed while discussing with the high achieving students.

Guidance Counsellors may be scared by the amount of time it take planning, developing and integrating the strategy in group work. Designing collaborative learning activities according to O'Donell (2006) is a complex task. Counsellors also need to understand how peer's interaction promote learning in order to make decisions about group activities. Students and parents most of the time are not comfortable with the grades given. This is why Johnson and Johnson (2000) suggested individual as well as group grading. The students may even find it difficult helping other students construct meaning especially linking new information with the culture and prior knowledge of the students. Since collaborative learning strategy is said to be student centred and all responsibilities shifted to the students some teachers may feel that the students are usurping their role and as such may look down on the students' contributions.

Collaborative learning classroom tend to be noisy because students discuss, walk about in their group or exchange groups. They also talk to or teach their group members. One who is not familiar with the strategy may term

it noise making and wonders how students could learn under such condition. Tinzman et al (1990) argued that the organized noise depicts full participation on the part of the students and that active learning is taking place. However, Tinzman suggested teaching the students the parameter within which they make their noise. Rules and standards must be stressed from the beginning; probably before any collaboration is initiated and should be reviewed throughout the year.

Status of individuals within the group may make some students consistent leaders and others followers. But the Counsellor discourages that. Opportunity should be given to every student equally. Also if this is not put under check, the person whose ideas are respected and valued in general may not be the one with the best opinion / approach or perspectives, as such some important perspectives may be thrown away thereby ignoring or loosing of important information to problem solving.

Furthermore, the group members may find their participating in group work as impediment to progress and often balk out or best still tolerate collaborative learning situation imposed by course design. Students may have reservations about their ability to work as part of a group (Harasin, Hiltz Teles & Turoff, 1998). They may become reluctant to participate based on negative experiences of working with unproductive or very difficult peers; having had to carry more than their fair share of the load or having received a grade that they

feel does not befit their level of contribution to a group work project (Brindley & Walti, 2009).

However, most of these problems or challenges can be managed and should not discourage any student who may wish to adopt it. The problems require time, leadership and support to address.

Empirical Studies

This section reviewed some available empirical research on collaborative learning strategy and related studies. It was discussed under the following subheadings:

Collaborative Learning

A research was conducted by Anis, Mahani, Latisha, Asmaak and Surina (2009) on the preference of collaborative learning among undergraduate students during lectures in English language. Variables like gender, location and programme were investigated upon to ascertain their influence on the preference. The study was to find out what the Malaysian students who took English Language lessons want to experience or expect during English language lessons. This is to enable them direct the English language instructors on what to prepare and how to select activities that would cater for their students' learning preference. The exercise took care of the students' better learning of the subject and resulted in better achievement.

The study was carried out using four groups of students comprised of science and social science students. A total of 162 students participated in the study; 93 students from science and 69 from social sciences. Furthermore, the respondents were made up of 90 males and 72 females. The participants responded to a Cantwell and Adrew's Feelings Towards Group Work Questionnaire and Reids Perpetual Learning Questionnaire (1987). The level of students'preference of collaborative learning was put into three categories, high, medium and low preference. Using t-test statistical analysis, the findings revealed that out of 162 students who participated in the study, none had low preference of collaborative learning during English language lessons. This indicated that all the students preferred collaborative learning. In terms of gender, there was no difference between preference level of the of male and female. It indicated that gender was not a barrier. It was further observed that social science students preferred collaborative learning strategy more than the science students.

Gokhale (1993) researched on collaborative learning and enhancement of critical thinking at Western Illinois University, Macomb, Illinois. The study was designed to investigate the effectiveness of individual learning versus collaborative learning in enhancing drill and practice skills and critical thinking skills. He randomly sampled 48 students from 271 Basic Electronic Course undergraduate students during spring. The participants consisted of 40 males and eight female students; 15 'drill practise' items and 15 critical thinking items

were administered to the students. The instruments were pretested and post-tested by the researcher to assess the effectiveness of collaborative learning. After carrying out statistical analysis on the scores using t-test and ANOVA, the result revealed that students who participated in collaborative learning group performed significantly better on critical thinking tests than students who studied individually. But on the aspect of drill and practice both groups performed equally well. The findings showed that collaborative learning enhanced critical thinking of the student. The result supported the theoretical views of Vygotsky (1978) which stated that students are capable of performing beyond their level if opportuned to collaborate with their peers.

In addition, a quasi experimental design was conducted by Jenson and Lawson (2010) to investigate the effects of collaborative learning group composition and inquiry instruction of Reasoning Gains and Achievement in undergraduate students Biology. The study was conducted at South Western Community College Arizona State University Tempe. The participants were spread across the white and minority races totaling 181 participants. The study lasted for eight sections covering two semesters of college introductory Biology. To determine the initial reasoning ability and reasoning gains, a modified version of classroom Test of Scientific Reasoning Version (2000), Lawson (1978) consisting of 24 items were administered. Also used was final examination scores to assess the students' achievement level. The result was analyzed using two way analysis of variance (ANOVA) which showed that

there was a significant difference on achievement and reasoning gains of the students. There was a greater increase on the students' achievement and reasoning ability. Inquiry section out performed non inquiry section indicating that inquiry leads to greater conceptual understanding. They also responded with better confidence in their ability to reason and presents more positive attitude towards collaborative learning. The result also showed that low reasoning ability students benefited more having been given opportunity to self regulate.

The effects of cooperative learning and problem solving strategies on Junior Secondary School students' achievement in social studies was compared by Adeyimi (2008). The study adopted quasi experimental design to investigate the effects of three strategies, cooperative learning, problem solving and conventional learning on the students' achievement in the study of social studies. The researcher adopted cluster sampling technique in getting the population. There were a total of 150 participants, 80 males and 70 female students within the range of 11 – 15 years taken from three public schools in Ife Central Local Government Area of Osun State Nigeria. The study lasted for four weeks; three of 35minutes per week. Findings depicted that students in cooperative learning classroom recorded highest performance. Boys appeared to benefit more in cooperative learning class than girls. The statistical result showed that boys and girls exhibited their maximum scores in cooperative learning class. Boys scored 11.42 and girls 11.00 as against 7.35 (boys) and

7.20 (girls) in conventional class. The researcher suggested that teachers should encourage team work among the students to enable them form the habit of cooperatively working together.

A research work was conducted by UNALAN (2008) on the effectiveness of collaborative learning application in Art Education. The design aimed at defining the effectiveness of collaborative learning application in Art Education training. Fourth year primary school students from Korgeneral Lûtfû Akdemir primary school in 2007/2008 Autum Semester were used for the study. The total population was not stated. However, primary 4A and 4B pupils formed the sampled population. The respondents were pretested and post-tested to decern the achievement difference of the two groups. Results of the findings were in favour of the experimental group. It was reported that collaborative learning was very effective in the visual Art education training. That collaborative learning facilitated Art training. There was in and between groups interactions. Also students' responsibility and social skills were enhanced and students were prepared for real life experience (Soller et al, 1996). Also observed was that the application of collaborative learning in Art Education training helps to increase students' knowledge of the subject, provide cultural accumulation, socialization and enhanced creativity among the students.

Chianson, Kurumeh and Obida (2010) researched on the effect of collaborative learning strategy on students retention in circle geometry in secondary schools in Benue State. The study compared the conventional

method of teaching and the use of collaborative learning in the teaching of geometry. The sample population comprised 358 SS II students from the three zones (Zone ABC) of Benue State. Using T-test analysis they were able to report that the students subjected to cooperative learning strategy retained the concepts of circle geometry more than the control group.

The studies also agreed with Nichols (2002) who reported that students in the cooperative learning group exhibited significantly greater gains in the post test and retention test in geometry achievement, efficacy, intrinsic value of geometry learning and good orientation. The study reported the use of deep processing strategies which however depicted that the students obeyed the rules of collaborative learning – elaborating and explaining to each and ensuring members understand the subject matter clearly. However collaborative learning enables the group members to understand geometrical concepts better, retain longer and recall faster than those in the control group.

A parallel study was conducted by Iqabl (2004) on Effectiveness of cooperative learning on Academic Achievement of secondary school students' Mathematics, (2 x 2) factoral design was used for treatment of data. The students of Urchu medium secondary school constituted the population of the study. The study aimed at determining the effectiveness of cooperative learning over traditional learning, low achievers and retention of students' mathematics. It lasted for ten weeks. Data analysis using t-test and analysis of covariance revealed that the experimental group outscored the control group significantly

showing the obvious supremacy of cooperative learning over traditional method group. Also recorded was that the mean score of low achievers in the experimental group was higher than those in the control group. On the retention rate, the retention test mean scores dictated that there was no significant difference between the groups. High achievers of both groups showed no significant difference on the mean scores. This depicts that low achievers benefited more from cooperative learning method than the high achievers.

Similarly, Kolawole (2008) carried out a comparative study on effects of competitive and cooperative strategies on academic performance of students in mathematics. The study compared the academic performance of students taught with cooperative learning and those taught with competitive learning strategy. It also compared the academic performance of boys and girls in mathematics of students taught with cooperative learning and competitive learning strategies. Participants selected were 400 comprising 240boys and 150 girls drawn from four out of five states in the south western Nigeria, all in SS III. The findings revealed that cooperative learning strategy is more effective than competitive learning. In addition, male students performed better than female students in the learning of mathematics with cooperative and competitive strategy. It was observed that there was gender influence with respect to performance in mathematics through cooperative learning strategy.

Furthermore, Overlock (1994) carried out a comparative research on collaborative learning and traditional learning method in physics class at

Northern Maine Technical College (NMTC). The participants were 30 students, eight in traditional method class and 12 in experimental group. The researchers aimed at comparing the mean final examination scores of physics students taught with collaborative learning with those taught with traditional method. The findings disclosed that there was no significant difference between the control group and experimental group. The students in the control group had a mean score of 18.17 while those in experimental group have 19.11 which showed that the two results were equally effective, the difference was insignificant statistically.

A study was done by Parveen, Mahmood, Mahmood and Arif (2011) on the effect of cooperative learning on academic achievement of 8th grade in social studied. The population was made up of 35 students from the 8th grade class of students in Mishal-e-lim Secondary School under the administrative control of Pakistan Air Force. The experimental group consists of 18 for control and 17 for experimental group. There was no mention of the particular cooperative learning method used but the difference was obtained by pretesting and postesting of the candidates and their annual examination in social studies. In analyzing the pretest, post test, mean scores of students and standard deviation were used. The result was that cooperative learning is not found a better learning instruction than the routine method.

*** Student Team Achievement Division**

A quasi experimental study was conducted by Armstrong (2008) at the University of Southern Mississippi on the effect of STAD on twelfth grade class students' achievement and attitude in social studies. The study was to determine if the twelfth grade advanced placement students who were exposed to STAD cooperative learning will score higher in a posttest than those students taught with the same material using traditional methods. The study lasted for seven weeks.

The researcher used convenient sampling technique to select 47 students from Grade Advanced Placement American Government School located at the Suburban setting of Mississippi. Using random sampling in sharing the students into two groups; 17 students for experimental group and 30 students for control group. Pretest and posttest achievement test were administered to the students. In addition, a measure of students' attitude questionnaire was administered to determine the students' attitudes towards the application of STAD in their learning of social studies. The scores obtained from the two instruments were analyzed using Analysis of Covariance (ANCOVA) and t-test. The findings revealed that there was no significant difference between the adjusted means of the two groups. Also there was no significant difference between the group means in attitude scale; yet students and teachers indicated liking for the STAD. The finding is important because, it demonstrated that STAD can be as effective a teaching strategy as the traditional method.

Another study too was carried out on the effects of collaborative learning methods on Achievement, Retention and attitudes of Home Economic students in North Carolina by Abu & Flowers (1997). The design was aimed at determining the effects of the collaborative learning approach of Students Team Achievement Division (STAD) on achievement retention of information and attitudes towards the instructional method of selected Home Economics students. A total of 197 participants, 91 in experimental and 106 in control group made up the sample. The study utilized California Achievement Tests derived from the state items bank of Home Economics and the first term semester grade scores in collecting data for measuring achievement and retention level of the students both before and after the treatment. Also used is the Self Developed Attitude Test Questionnaire.

Report of the findings indicated that students who were taught with cooperative learning method performed equally as well as those in the control group. Their attitudes towards cooperative learning were the same too. From the study one may say that the timing may have affected the result. The time (three weeks) was too short for a difference to be observed. That was why the present study lasted for six weeks to avoid the mistake made by Abu and Flowers. For the students to record high attitudes toward the strategy showed that there may be other reasons why students wanted to continue working in group. It may be the ability to work with others and to develop interpersonal skills. Also, they

must have gained an interesting experience within the short period the exercise was introduced.

Also, the effect of STAD on achievement of students in chemistry was conducted by Gul and Hafiz (2009). The researcher aimed at investigating the effects of STAD and traditional method of teaching on the students' learning of chemistry. Population of the study constituted all students studying chemistry at Higher Secondary School level in Khyber Pukhtunkhwa (Pakistan). Thirty students were randomly sampled from the population. The researchers made use of posttest achievement test only. Using t-test statistical analysis, it was observed that there was no significant difference in the achievement of both groups. The achievement of students in experimental group after treatment did not differ with those in control group that had no treatment at all. The no difference in achievement might be as a result of experimental bias (the researcher being the instructor). Also, there was no pretest before the treatment. How could the researcher determine the initial intellectual status of the students that will enable him to ensure the heterogeneity of the group. There was no base for random assignment of the students into groups. The result cannot effectively be ascertained.

Furthermore, Ibraheem (2011) looked at the effects of two modes of STAD in the study of Chemistry Kinetics (STAD) with inter team competition and STAD without inter team competition. The study aimed at finding out which of the modes of STAD will be more effective in the students study of

Chemistry Kinetics. Both pretest and posttest achievement test and students' Chemistry kinetics attitude questionnaire were utilized in determining both the achievement level and attitudes of students. The study revealed that STAD without competition was more effective than STAD with competition. The researcher commented that competition which characterized one of the techniques is in line with traditional method and might have affected the performance and productivity of students negatively. The control group performed better than the experimental group.

A quasi experimental study on the effectiveness of cooperative learning versus traditional method was carried out by Shafgat (2008) at Pakistan. The study aimed at finding out the effect of cooperative learning (STAD) on the learning of English Language writing and reading ability of students in class VIII. One hundred and twenty eight students from Government Comprehensive Boys' High School Ralwalpindi were purposefully sampled to participate in the study. The control and experimental group comprised 64 students respectively. In the analysis, t-test and mean standard deviation come to play. The result revealed that the experimental group out performed the control group. The difference was attributed to STAD.

Another quasi experimental study was carried out on the effects of STAD – Cooperative Learning method on student achievement, attitude and motivation in Economics education by Myk Van (2012) at the College of Education, University of South Africa. The study aimed at exploring the effects of STAD

on students achievement, attitude and motivation in economic education. The population comprised 168 third year Bachelor of education student teachers who were selected through proportionate stratified random sampling; 109 male and 59 female students. Three research instruments, a Test of Economic Literacy (TEL) a motivation scale and Education Modular Test were employed in data collection. Findings showed that STAD promoted positive attitudes and there was better achievement and motivation on students learning in economics education.

Also, a quasi experimental study on effect of cooperative learning strategy on learners' mathematics achievement by gender was conducted by Njoroge and Githua (2013). The study aimed at determining the effects of student team achievement division (STAD) teaching strategy on students mathematics achievement in scale drawing topic by gender. Simple random sampling was adopted in determining the sample size of 323 students from co-educational district secondary school, Nakuru district. The sampled size comprised 161 boys and 162 girls. Also the study was carried out in mathematics classroom setting using Solomon 4 designs under quasi experimental. An achievement test in mathematics was administered before and after the treatment. The result was analyzed using T-test and ANCOVA to test the hypotheses at 0.05 level of significance which yielded that STAD is better in removing gender difference gap in students learning of mathematics achievement.

Another quasi experimental study was undertaken by Shafgat (2008) to evaluate the effectiveness of cooperative learning versus traditional learning method. The study was carried out at International Islamic University Islamabad. Its purpose was to evaluate the effectiveness of cooperative learning method in English Language. The study however focused on the effect of cooperative learning and traditional learning on the achievement of students in the reading comprehension and ability of students of Class VIII in English. The researcher adopted (STAD) technique in the treatment which lasted eight weeks. Through purposeful sampling, 128 students within the age level of 13 and 14 years from 8th class in Town School Pakistan were selected and shared into two groups; 64 students in experimental group and 64 students in control group. Pre-test posttest teacher made achievement tests were administered to the students before and after the treatment to measure the achievement in reading comprehension and writing ability of students. The scores were analyzed using T-test and analysis of variance.

It was gathered from pretest result that both the experimental and control groups were almost equal in performance in reading comprehension and writing ability. The experimental group outscored the control group significantly on the posttest showing supremacy of STAD over traditional method. The finding also stated that cooperative learning method (STAD) is very effective. It appeared to be more favourable for overcrowded classes.

A study on the effect of STAD technique and the achievement of 10th year students of SMA Negeri 4 Singaraja was carried out by Budiata, Padamdewi and Budasi (2012). The study aims at investigating whether the implementation of STAD technique and the students motivation will give a significant effect on the students' writing achievement. A quasi experimental study applying 2 x 4 factoral design was employed. Population of the study consisted of six classes (240 students) of grade ten SMA Negeri 4 Singaraja in the academic year of 2011/2012. The experimental group was made up of two groups 80 students each. The study adopted cluster sampling and used achievement test for data collection. The information was analyzed by employing statistical two-way ANOVA and Turkey Test.

The result of the findings showed that there was a significant improvement on the writing achievement and interaction effect of students exposed to STAD when compared with those that used traditional method.

Furthermore, Van (2012) investigated the effect of cooperative learning on the academic achievement of students in mathematics and the attitude of 74, 9th grade mathematics students in higher school in Vietnam. Pretest Posttest non equivalent comparison group design was employed. The 74 students were randomly sampled and shared into two, 36 (19 females and 17 females) for experimental group, then 38 students (21 females and 17 male) constituted the control group. The researcher used 40 item pretest posttest achievement test for measuring the achievement in mathematics and Aiken's Attitude Scale 1974 to

measure students attitudes. The attitude scale has two components; Enjoyment of mathematics which has 11 items and value of mathematics which is made up of 10 items. The experimental group were treated with Student Team Achievement Division (STAD) technique while the control group utilized conventional method.

From the statistical analysis using t-test it was revealed that after five weeks, the experimental group achieved significantly higher scores on the mathematics posttest achievement test than those in the control group. Also the students taught with STAD had significant higher scores on both the Enjoyment and Value scales of attitude towards mathematics. The study concluded that cooperative learning was effective in improving the academic achievement level of participating students and in promoting positive attitudes of students towards mathematics in Vietnam High School.

Studying on the implementation of cooperative learning method using Student Team Achievement Division (STAD) model to improve learning activity and learning outcome for VIIB graders in Economics, Ike (2011) focused on students of laboratory Junior High School SMB State University Malang. The population of the study consisted of 42 female students from accounting class. The aim of the study was to find out whether STAD model of cooperative learning can improve learning activity and learning outcome in Economics. Qualitative and quantitative instruments for data collection

(interview, observation, test, questionnaire, field note and documentation) came to play.

There was no indication on how the analysis was done or statistical analysis technique used. However, the result shows that STAD is effective in improving students' learning activity and learning outcome. Many students performed above minimum accomplished standard score. As a result, the researcher suggested that Economics teachers should adopt STAD model in teaching Economics.

Another study was conducted using STAD on the effect of cooperative learning on academic achievement of secondary grader students in mathematics by Majaka, Mamood and Saeed (2012). The study aimed at assessing the effectiveness of cooperative learning on the academic achievement of high and low achievers at secondary level in mathematics. The researcher adopted quasi experimental design with pretest, posttest. The participants were 53 students of 10th class of Government High School DAV college road Rawalpindi district Rawalpindi. The students were shared into two groups using pretest scores, 28 for experimental group and 25 for the control group. Those students in experimental groups were taught with STAD cooperative learning method while the control group used traditional method. The study lasted for 6 weeks with 18 lesson plan, after which the teacher-made posttest was administered to the students. After six weeks the students were left to continue with the other chapters, then another posttest was given to examine the retention of the

students of both groups. T-test was used in analyzing the achievement and retention measures.

The result showed that cooperative learning groups performed significantly better than the control group.

*** Jigsaw**

On the effect of Jigsaw collaborative learning strategy Abdullah (2010) undertook a research on the effect of Jigsaw II strategy on students' academic achievement and attitudes to written expression course. The study aimed at exploring the effect of Jigsaw II and instructional method of teaching on Turkish language teacher education. The participants were 80 students from Turkish University; 42 and 38 students were randomly sampled for experimental and control group respectively. The pretest and posttest used were Attitude of Writing Expression Scale (ATWAES), Written Expression Achievement Test (WEAT) and Student View Form (SVF). Statistical analysis revealed that there was significant difference between experimental and control groups. The experimental group also had positive views about, Jigsaw II. The researchers attributed the success to students completely learning of the subject by fulfilling their individual responsibility; making friends and understanding the topic in question.

A comparative study on the effect of cooperative learning method and Jigsaw techniques on the teaching of literacy genres was done by Ali (2010).

The study was aimed at comparing the level of effectiveness of Jigsaw technique applied in the teaching of Literacy genres with that of conventional teaching method. A total of 60 students, 30 from Branch A and 30 from Branch B in the 11th grade of Kayseri State High School of 2008/2009 session constituted the population of the study. In addition, quantitative and qualitative research design – pretest posttest achievement test, questionnaire list and interview were conducted for data collection. From the findings, it was observed that Jigsaw was more effective than the conventional method.

Also, Maden (2011) carried out a study on the effect of Jigsaw I Technique on achievement in written expression. The study aims at comparing the effect of Jigsaw I technique and traditional method on academic achievement and retrieval of Turkish teaching candidates in the matter of written expression. The participants were 70 students studying at the Department of Turkish Teaching Course in 2009/2010 academic year; University of Atakurk. Two intact classes were used as experimental (36 students) and control groups (34 students). Success Test For Written Expression was used in collecting data. The statistical analysis from two way ANOVA showed that there was no significant difference in favour of the experimental group;which showed that jigsaw and traditional method are equally effective. Kolb learning style inventory reported differently.. From the students' views it was deducted that Jigsaw I increases success, encourages self confidence, develops cooperation and interaction, makes students to be more active and

encourages zeal to research. The Klob inventory used on students reported differently from the students achievement. The argument being that if students could assert so positively about Jigsaw, there would have been a significant difference in achievement. Then there must be a problem somewhere; may be in population constitution or implementation of the technique.

The present researcher ensured that the students are placed appropriately in groups (mixed intelligence). Research assistants were trained for the four sampled schools to monitor students' participation effectively and direct them aright.

A study was conducted by Hanze and Berger (2007) on collaborative learning motivational effects and students characteristics: An experimental study comparing collaborative learning and direct instruction on 12th grade physics classes. The study adopted quasi experimental design. Population was 137 students of 2002/2003 school year of University of Kassel Germany. The study aimed at comparing Jigsaw classroom method of instruction with traditional direct instruction.Results from Multivariance analysis of variance, MANOVA showed significant main effect on method of instruction. It revealed that there were differences in students experience of the three basic needs (autonomy, competence and social relatedness as posited by self determination theory of learning) in self reported cognitive activation and degree of intrinsic motivation. This study also failed to show positive effect of jigsaw on academic

performance of the experimental groups. Jigsaw experimental group performed lower than the students taught with traditional method.

A quasi experimental study with pretest posttest design was adopted by Mahnaz (2012) to investigate the effect of Jigsaw technique on the learners reading achievement. The study attempted to provide a comprehensive examination of the effect of Jigsaw II teaching method on the success of Iranian EFL (English as a Foreign Language) learners in terms of their reading comprehension achievement. The participants were Engineering, Management and Biology students of University of Guilan Iran. All participants were Persian speaking learners of English.The study lasted for ten sessions of a whole semester. Pretest, posttest TOEFL test administered to the students before and after the treatment. From the t-test analysis, the experimental group scored high in the post test mean score of 30.34 and pretest 26.78 against the mean score of control group, post test = 20.05, presttest = 26.68. The result revealed that Jigsaw cooperative learning technique has significant effect over the control group. It was reported that Jigsaw motivated students to learn a lot of materials quickly and inspires them to share information with peers. It also made students responsible for their own learning.

Another study was also conducted by Ghina (2007) on the effect of Jigsaw II versus whole class instruction on EFL students reading motivation and achievement. The study aimed at investigating the question of whether Jigsaw II is more effective than whole class instruction. A total of 44 grade five

students in private schools in Lebanon (American University of Beirut) constituted the population of the study and were randomly assigned to experimental and control groups.The study applied only posttest design and the treatment lasted for eight weeks. After the treatment posttest of GMRT and MRP were administered. In analyzing the data, a multivariate analysis of variance (MANOVA) was conducted to compare the results of both the experimental and control group. The result indicated that Jigsaw II had a significant motivating effect on students' reading comprehension and achievement.

In another study Gomleksi (2007) investigated on effect of cooperative learning (Jigsaw) method in teaching English as a foreign language to engineering students (case of Firat University Turkey). The study aimed at comparing the effect of the Jigsaw method and traditional teacher centered method in improving vocabulary knowledge and active-passive voice in English as a foreign language, for engineering students and their attitudes towards the learning of English. The participants consisted of 66 engineering students of Firat University Turkey. The students were randomly assigned to experimental and control groups. The findings obtained from t-test and ANOVA showed that there was a significant difference in favour of Jigsaw.

In the same way, Arin (2012) studied on improving students' reading comprehension using Jigsaw. It was a classroom action research conducted at SMB Islamic boarding school MTA Gemolong on 2nd grade students in

2010/2011 academic year. Objective of the study was to improve students' reading comprehension through Jigsaw technique and to describe what happened when Jigsaw technique is applied in the teaching and learning process. Students used for the study were from 8A class of SMP, MTA, IBS Gemolong.The action research was conducted in Two cycles, each consisting of four steps – planning, acting, observing and reflecting. The researcher adopted qualitative and quantitative method. Observation technique involved, filed notes and photographs, while non observation technique is made up of interviews and documents. The quantitative was inbuilt in pretest post test achievement test. The instruments were analyzed step by step – assembling, coding, comparing building, interpreting data and report outcome. Non-independent t-test was used in analyzing the qualitative data. The researcher analyzed the mean scores of the tests. The improvement of the students reading comprehension was indicated by the scores of the post-test which was found to be higher than the scores of the pretest. It was observed that there was a significant improvement of the students' reading comprehension. The finding also revealed that Jigsaw could improve the students' interest. Further it showed that the instructional process was not dominated by the teacher. The class was lively because students were very much involved. The researcher further observed that JS also improved students' social development.

Nugrahawati (2011) repeated the study at SMA Negeri I Tuban. His study was on the effectiveness of Jigsaw in increasing the tenth year students'

activity in reading comprehension. The population of the study was 80 students in 2 classes of XA and XB who were in the academic year of 2011/2012. Its purpose was to find out whether or not Jigsaw has some effect in increasing 10th year students' ability in reading comprehension and how far the 10th year students responded to JS for increasing ability in reading comprehension.

Pretest, posttest achievement test were administered to the students before and after the treatment. The study adopted descriptive analysis for quantitative data and non descriptive t-test for determining the significant difference. The posttest scores indicated improvement of students reading comprehension. The scores were higher than that of the pretest. The mean scores increased from 5.7 (pretest) 6.4 (posttest I) and 7.5 (posttest II). This showed that there was significant improvement of students' reading comprehension and that Jigsaw can improve the students' interest in reading comprehension. Based on the findings, the researcher suggested that English Language teachers should use Jigsaw in enhancing students reading comprehension and establishing a good atmosphere in the class. This he maintained would improve students' involvement in the learning of English Language.

Also Luthfilah (2010) dwelt on the students' reading ability by investigating on the use of Jigsaw technique in improving the ability of the 11th graders of MAN Lamongan in reading narrative texts. The study was conducted at JI Veteran 43 Lamongan. The objective of the study was focused on

improving the ability of the 11th grader BHS-2 MAN Lamongan reading narrative texts. Population of the study consisted 34 students. From the preliminary study, it was discovered that only ten students out of 34 met the minimum mastery standard. Jigsaw technique was applied in teaching the experimental group. A collaborative action research of two cycles was adopted. The result indicated that Jigsaw was an effective learning technique. In terms of attitude, 31 out of 34 students (91.18%) stated that Jigsaw and group work involved helped them in comprehending the narrative text. Another study was carried out by Van and Ramon (2011) on the effect of cooperative learning on students of An Ghiang University in Vietnam. The study investigated the effect of Jigsaw cooperative learning on the achievement and knowledge retention of 80 final year Vietnam mathematics students as well as reporting their attitudes towards Jigsaw form of learning. The sample comprised 80 students, 32 females and 48 males, from two mathematics classes in the Faculty of Education An Giang University in Vietnam. The students were shared into two groups based on gender, age and Gross Performance Achievement (GPA) scores. There were 24 males and 16 females in each group.

The instruments for data collection was 30 item Mathematics Achievement Examination (MAE) and 2 survey questionnaire of 26 items each for retention and attitude measures. Also the statistical analysis used was ANCOVA which was applied in comparing the group posttest and retention test, Bonferroni pairwise comparisons for determining significant difference

between the two groups and a repeated measures analysis of Variance (MANOVA) performed to compare the mean scores of the four scales measuring different aspect of instruction. Result of the statistical analysis proved that there was a significant difference between the achievement and retention of students exposed to Jigsaw and those in lecture method class. Jigsaw cooperative learning method recorded higher overall improvement in scores on the MAE, – Students' attitudes were overwhelmingly positive. The improvement was attributed to reciprocal interactions among participants around interactive learning tasks and active role of participants. It was also reported that there was healthy communication flow, mutual cooperative and exchange of needed resources. There was greater retention difference because students in Jigsaw group spent more time in preparing the materials and discussing issues.

A quasi experiment was conducted by Rica (2008) using Jigsaw to increase students' reading comprehension. The main purpose of the study was to find out whether Jigsaw model could increase students' reading comprehension and increase the students' participation in reading comprehension activities in SMP Muhammadiyah 2 Batu. Action research was adopted. The experiment was conducted and activities observed. Data were collected using observation. The researcher observed not only the students increase in reading comprehension but also to observe their participation during reading comprehension. The result revealed that Jigsaw cooperative learning

could increase students' comprehension reading because group members were led to solve their problems together. They were able to help one another understand the context of the text and find solution to the problem. Jigsaw also increased students participation in class discussion as well as ability to speak English. It forced every member to participate fully.

*** Number Heads Together (NHT)**

Study was carried out by Maheady, Michieli – Pendl, Harper and Mallete (2006) with sixth graders in urban location of New York. One Chemistry class made up of 23 students was used for the study for the purpose of discovering achievement difference between NHT plus incentives and NHT, without incentives. A highly experienced teacher with 28 years of experience taught in the two groups. Terra Nova achievement test was given before and after the treatment. Also the students were subjected to daily quizzes. It was discovered that the class which received the treatment NHT with incentives had 89.2% gain in achievement, while the other group had 82.1%. Also statistically, the class with traditional method had 72% gain in achievement difference. It appears that Number Heads Together with incentives for the sixth grade urban class was more beneficial in teaching chemistry.

In another study Maheady, Mallete, Harper and Sacca (1991) compared NHT and traditional methods for 3rd grade academic students achievement. No mention was made of the location. Only one third of the class was involved in

the study. The teacher used had 15 years of experience. The mean percentage of achievement was on daily quizze was 70.46%. Third of the class has 65% and six students had failing average grade using the traditional method. But during the Number Heads Together the six students kept above averages (90%) range. When another teacher who had no training on NHT was introduced to handle the class, the achievement of students dropped to 70%. The study depicts that NHT enabled more achievement to be recorded. And researchers noted that there was no student failures during the application of NHT.

A study on effect of Number Heads Together (NHT) on reading comprehension achievement of 8th grade students at SMP Negeri 2 Tamanan Bodowoson was conducted by Ratih (2012) at Jember University. It was aimed at investigating whether or not there is a significant effect of NHT technique on reading comprehension of 8th grade students at SMP Negeri 2 Tamanan Bodowoso in 2011/2012 academic year. The study adopted lottery in sampling the participants before and after the treatment. The results obtained were subjected to t-test and ANOVA statistical analysis.

The result recorded that statistical value of t-test was higher than that of value table with significant level of 5% (2.78 > 1.99). Based on the result, it was deducted that NHT significantly affected the students' reading comprehension achievement. DRE was employed in order to find out extent of the effect. The degree of relative effectiveness was 12.7% which meant-that NHT was 12.7% more effective than the lecture method. It was then concluded

that NHT gave a significant effect on student reading comprehension achievement. English teachers were advised to introduce the use of NHT in their teaching of reading comprehension.

A study on comparison of the difficulties between cooperative learning and traditional teaching method in college English teachers of Kun Shan University was conducted by Tzu-Pu (2007). The study aimed at introducing how a college teacher could conduct his teaching using different cooperative learning and comparing them with the traditional teaching method. It compared cooperative learning methods (STAD, JS, NHT, LT) with traditional method. There was no indication of the sampling technique, population size and method of data analysis. However, the researcher employed qualitative research methods-interviews, observations and reflections of the teaching journals. He observed his class in cooperative learning environment and noted the students' behaviours. Interactions in the class teaching journal was observed too. The leader of the teams' sheets, individual observation notes, group evaluation and self evaluation notes were gathered, transcribed and scored. Furthermore, the researcher interviewed two professors H and P who were good at using cooperative learning methods and two professors of EFL who were conversant with the traditional method (Lecture method). By the end of the exercise the difficulties of both methods were enumerated thus:

Cooperative learning: free riders effect, the unified course schedule, designing meaningful activities, managing noise and coatic classroom. For lecture

method, it has the difficulties of teacher led style, too much teaching, explaining and drilling activities, lack of activity and interaction. However, the result indicated that cooperative learning methods helped to create student centered environment which necessitated great academic achievement, affective and personal social development of student.

Another study by Bawn (2007) looked at the effect of collaborative learning and engagement. The study explored cooperative learning methods to determine if they were beneficial in reducing the achievement gap which resulted in high dropout rate. The researcher reviewed critically several literatures on the methods of cooperative learning, such as STAD, Team Game Tournament (TGT), JS, NHT, Learning Together (LT) Group Investigation (GI), Complex Instruction (IC), Team Assisted Individualization (TAI), Cooperative Integrated Reading and Composition (CIRC) and Bilingual Cooperative Integrated Reading and Composition (BCIRC).

On the process the researcher reviewed 11 studies with the purpose of considering the effectiveness of cooperative learning and lecture method on African American, Native American and Latino students. Majority of these studies dwelt on STAD, TGT, TAI, NHT, JS among others. Among the studies reviewed were Vaughan 2002, Oickle and Slavin 1981, Slavin 1977, Scott 1984, Fan 1990.

The findings reported, better achievement gains for African American and Mexican Americans in many of the studies when compared with traditional method. Also that students learning was cooperative rather than competitive.

Bilasnami-Awoderu and Oludipe (2012) carried out a quasi experimental pretest posttest, delayed posttest control group design on effectiveness of cooperative learning strategies on Nigerian Junior Secondary School Students academic achievement in Basic Science. The study was conducted at Olabisi Onabanjo University, Ago-Iwoye using 120 students selected from three Junior secondary schools in Ogun State, Nigeria. The purpose of the study was to investigate the effectiveness of cooperative learning strategy in Nigerian Junior Secondary academic achievement in Basic Science. The moderator variable was anxiety.

The researcher applied two models of cooperative learning – Jigsaw and Learning together in treating the experimental group while the control group was restricted to conventional method. Instruments employed were Achievement Test for Basic Science Students (ATBSS) and Basic Science Anxiety Scale (BSAS). Method of data analysis was descriptive analysis, ANCOVA and Multiple Classification Analysis (MCA) to determine both the significant difference and the magnitude of the mean achievement scores of the students exposed to different treatment conditions.

The findings revealed that there were significant main effects of treatment on all the departments measures. Also there was significant main

effect on anxiety of students post and delayed posttest achievement scores of students. Furthermore, there was a significant interactive effect of the treatment on anxiety and the academic achievement of students at the posttest and delayed posttest level. Therefore, the study showed that students in the two cooperative learning model groups had higher immediate and delayed academic achievement mean scores than the students in the conventional group. Learning Together (LT) and Jigsaw were found to be more effective in enhancing students' academic achievement and retention in Basic Science more than the conventional method. The researcher maintained that when friendliness is established, students are motivated to learn and are more confident to ask questions from one another for better understanding of the material being learnt.

Another comparative study was carried out by Jeanie (2011) on whether cooperative learning structures can increase students achievement. The study compared achievement scores of 6th grade social studies students who participated in classes using Spencer Kagan's Structure of cooperative learning with students who did not. The main aim of the study was to find out whether the 6th grade social study students at Dunbar middle school who participated in Kagan Cooperative learning structure will gain high curriculum based assessment scores than students who used traditional method. The measures were curriculum based and the mean scores of each class compared.

The researcher used heterogeneous groups, that is, students with varying abilities from mentally impaired, to gifted students duely placed in all the

groups. The participants consisted of 50 students within the age range of 11 and 12 years clusterly drawn from Dunbar middle school in Fairmont, Western Virginia, Non-equivalent posttest only was employed with one group receiving treatment using cooperative learning (STAD, Think Pair Share (TPS), NHT, Rally Table (RT) and show down (SD), while the other group was taught with traditional method. The study lasted for nine weeks. The students' achievement was measured through curriculum based assessment instruments designed by the teacher. The result as equitably assessed using one-tailed unpaired t-test.From the result, the assumption that using cooperative learning structure would result in higher achievement was proven. Also evident was that cooperative learning structure can be used successfully for students of diverse abilities.

Also Santosh (2012) compared the effect of student Team Achievement Division and Jigsaw methods of cooperative learning strategy. The purpose of the study was to compare the effective of STAD and JS methods of cooperative learning strategy on the students' outcome and self-concept in mathematics' classroom of the 7th graders. The achievement was measured in terms of the scholastic achievement and enhancement of self-concept of the students. A quasi experimental study with pretest, posttest design was employed on 90 students studying in three sections of 7th class of SBS Senior Secondary School Karnal. Through purposeful sampling the students were shared into three groups of 30 students each. The experimental group were taught with STAD

and JS respectively while the control group was treated with conventional method.

Data was analyzed by applying suitable statistical Techniques, Batlett S-test, analysis of variance and t-test to measure the differences in the mean and mean gain scores in achievement and self-concept of the groups. From the result it was gathered that STAD and Jigsaw method contributed towards raising the academic achievement and self-concept of students in mathematics in contrast to the traditional method. There was a significant high mean and mean gain scores in achievement and self-concept than the control group.Jigsaw showed a significant high mean gain scores in achievement than Student Team Achievement Division. The study also reported that there was no significant difference between STAD and JS in self-concept. The researcher suggested that STAD and JS are equally effective in developing self-concept among students even though JS appeared to be higher in mean scores than STAD.

Furthermore, Hsiu-Chuan (1999) compared cooperative learning and traditional whole class methods in the teaching of English Language in Junior College. The study examined and compared cooperative learning techniques (STAD, JS, NHT) with the traditional whole class method in terms of the English Language achievement of Junior College Students. The participants were 97 Kang-King Junior College nurses. Though the sampling method was not mentioned, the participants were shared into two groups, 48 students for control group and 49 students made up the experimental group. The study lasted

for two months of two hours twice a week. The experimental group were taught with STAD, JS and NHT while the control group were taught with traditional method.

An investigator – made achievement test was administered to the participants on two different occasions (mid term and final examinations). A t-test analysis was employed to determine whether the experimental class achieved higher overall scores than the control class. The result revealed that the students in the experimental group achieved significantly higher than the control group. The achievement gain was attributed to the technique's reward structures and carefully structured interactions among the students.

Summary of Review of Related Literature

The researcher reviewed related literature on effectiveness of collaborative learning strategies in enhancing academic achievement of students in Mathematics. The reviewed literature proved that academic achievement is the outcome of educational instruction measured by administering of tests or any other assessment tools compared with a set standard. Collaborative learning is the coming together of people to solve one academic problem or the other in full participation and the application of collaboration in solving education problems. Collaborative learning strategy also is a teaching and learning approach that enables students to work in unism in small groups or in pairs

seeking better ways of learning thereby owning their learning and helping each other in the group to learn.

The researcher further looked at the concept of collaborative learning strategy from what people said and argued upon. Five elements were identified as ingredients for collaborative learning strategy: positive interdependence, face to face promotive interaction, individual accountability, appropriate use of collaborative skills and group process. Many authors, Slavin, Johnson and Johnson, Arends, Cohen among others, argued that collaborative learning strategy is beneficial to students, the challenges not withstanding. From the theoretical studies, collaborative learning was categorized into three major headings – formal, information and group based, every other collaborative learning strategy falls under these categories.

In addition, the researcher tried to show that collaborative learning strategy is deep rooted in theories of learning. The theories reviewed were categorized under three headings; behavioural, social interdependence and cognitive theories. Behavioural theory of Bandura as related to collaborative learning activities was discussed. Also reviewed was the social interdependence theory of Morton Deutch followed by cognitive development theories of Vygotsky and cognitive elaboration theory of O'Donnel, Dansereau and Webb. Furthermore, empirical studies by some experts in collaborative learning strategy and related studies were reviewed and analyzed.

From the reviewed studies, it was evident that none of these studies was investigated on SS I students and none was conducted in Anambra State. More importantly, all the empirical studies reviewed looked at collaborative learning as a teaching method and not as a learning strategy by students and for the students. Therefore, this study, effectiveness of collaborative learning strategy in enhancing academic achievement of SS I students in Mathematics in Anambra State Secondary Schools hopes to fill in the gap in knowledge.

CHAPTER THREE

METHOD

The procedures taken in this study were discussed under the following headings; Research Design, Area of Study, Population of the Study, Sample and Sampling Technique, Instrument for Data Collection, Validation of the Instrument, Reliability of the Instrument, Method of Data Collection, Method of Data Analysis,

Research Design

The researcher adopted quasi experimental design. Ali (1996) has it that once the subjects are not randomized and the researcher used intact classes the study is no longer a true experimental design. One of the variables was put under controlled conditions. Below is the symbolic representation of the design.

Figure I

Pre-test-Post Test Control Group Design

Group	Pretest	Treatment	Post Test
E_1	B_1	T_1	B_2
E_2	B_1	T_2	B_2
E_3	B_1	T_3	B_2
C	B_1	0	B_2

Where E_1, E_2, E_3: Experimental Groups

C: Control Group

B_1: pretest

B_2: post test

T_1, T_2, T_3: treatment (Student Team Achievement Division, Jigsaw, Number Heads Together)

0: no treatment

B_1 and B_2 represented instruments administered to the subjects which are measure of their performance on the dependent variables. The pretest and posttest were the same though reshuffled and renumbered (Appendices A and B). The experimental group comprised the experimental and control group. The control group was not exposed to any treatment but used conventional method during the preparatory classes. By the end of six weeks their performance was compared with those of the experimental groups who were exposed to treatment on collaborative learning strategy.

Area of the study

The study was carried out in Anambra State. Anambra state, is bounded in the north by Enugu State, in the East by Abia State, South by Delta and west by Kogi state. Anambra state has six education zones – Aguta, Awka, Nnewi, Ogidi, Onitsha and Otuocha with a total of 256 secondary schools, (Post Primary Schools Service Commission (PPSSC) 2011). The study concentrated in Awka Education zone in Anambra State. Awka zone was appropriate because the PPSSC headquarter is located at Awka. Awka being the State capital is assumed will have a calm environment for academic activities but there are many distractions.The town is filled with numerous restaurants and hotels. Unfortunately students are negatively influenced by them. Okada (motor cycle) and keke (tri-cycle) riders draw students'(both male and female) attention away from academics.This

drastically affect their academic achievement. Awka metropolis has 14 Secondary Schools comprising coeducational (boys and girls), single sex (boys or girls).

Population of the Study

The population of the students is 15,530 SS I students (PPSSC, 2012) in 256 Anambra State Secondary Schools.

Sample and Sampling Techniques

The sample of the study consist of 173 SS I students. The researcher random sampled (using balloting) one education zone (Awka education zone) out of the six education zones in Anambra State. Also four co-educational secondary schools were random sampled from seven co-educational schools in Awka Zone that have professional counsellors. The co-educational secondary schools with professional counsellors were used to ensure uniformity in school setting.

Purposefully, intact classes were selected for the study. Since all the schools have more than one class of SS I, the intact classes were obtained through balloting, one from each sampled school

Instrument for Data Collection

The instrument used for data collection was a 35 item achievement test developed by four mathematics teachers from the sampled schools who volunteered to participate in the study. They went through the second term scheme of work of SS 1 students and picked those topics which the four schools have commonly covered. The topics were, Direct and Inverse Variation, Joint and

Partial Variation, Geometrical Constructions: Drawing and Measuring straight lines, Bisecting lines and angles, Constructing different angles and triangles using a pair of compasses and a ruler. Based on these topics, the mathematics teachers drew achievement test which was administered to students before and after the treatment. The achievement test covered two domains of education cognitive and psychomotor domains which are very much related to the study. Questions on variations took care of cognitive made up of 30 objective items carrying 2 marks each (Appendix A); while the psychomotor domain was represented by the geometrical construction with five questions, each correct arc or drawn line has 1 mark each (Appendix A).

Validation of Instruments

The draft of the achievement test constructed by four teachers from the sampled schools was face and content validated by two team leaders who are mathematics examiners of West African Senior Secondary Certificate Examination (WASSCE). The instrument was later given to two lecturers in Mathematics Department and Measurement and Evaluation of Nnamdi Azikiwe University Awka.

The validates were given the topic, purpose of the study, research questions and SS 1 second term scheme of work. They examined the items critically, saw some weaknesses and made some corrections and recommendations. Initially the items were 40 but were thinned down to 35. Item numbers 7, 16, 19, 21 and 38 were expunged while 8, 17 and 18 were restructured. Other items were retained. (Appendix A)

Reliability of the Instrument

To determine the reliability of the achievement test, the researcher used students from Community Secondary School Ugwuoba who had the same academic background with the sampled schools. A total of 120 SS 1 students (three classes of 40 students each) participated in the exercise. Treatment was given to the three classes on the learning techniques. SS 1A was treated using NHT, SS 1B Jigsaw and SS 1C, STAD.

The researcher with the help of the mathematics teacher, administered the test to the students. The mathematics teacher marked the scripts on the spot and handed over the scores to the researcher. After two weeks, the same instrument though reshuffled and renumbered were read ministered to the students. The scripts were marked and scores recorded. The scores obtained from the two tests were subjected to Pearson Product Moment Correlation Coefficient. The result yielded 0.80 (STAD), 0.76 (JS), 0.73 (NHT) values respectively.

Method of Data Collection

The data were collected using teacher made achievement test drawn from two units of instruction of SS 1 second term scheme of work. This was administered to the students (both experimental and control groups) before and after the treatment.

The mathematics teachers from the sampled schools were used in administering the achievement test. They collected marked and scored the test items and handed over the achievement test scores to the researcher. The

achievement test was read ministered after the treatment to both groups and the score analyzed by the researcher to determine the mean gain scores. The mean gain scores were then used in ascertaining the effectiveness of the collaborative learning strategy.

Training of Research Assistants

The researcher organized a two-day orientation programme for the research assistants to orientate and acquaint them with necessary skills in the use of collaborative learning strategy in the students' learning of mathematics. The training was necessary because it enabled the researcher and the research assistants to take decisions on certain important issues so as to ensure uniformity. Issues like:-the criteria for deciding when students must have mastered the topic,

- guide on students' activities,

-drawing of the time table for the preparatory classes,

-deciding on group incentive (reward/commendation),

-agreeing on the specific objectives for the treatment.

The research assistants who are regular school guidance counsellors, having equal counselling experiences and considerably of equal potentials were from the sampled schools. The content of their training were:

- Meaning of collaborative learning strategy
- Importance of collaborative learning strategy
- Different techniques of collaborative learning strategy with emphasis on STAD, JS and NHT.

- Class climate team building techniques.
- Rules of the games (Expectations from the students).

The research assistant for the control group was instructed on how to guide and monitor the students' learning of mathematics using other individually based learning habits under normal classroom setting.

Training Sessions: 1st Day

The three assistants convened at Zonal Office (PPSSC Awka), (the researcher's office), the agreed convenient place. The researcher created rapport, exchanged greetings with the research assistants, carried out informal introductions. She introduced herself - a post graduate student of Nnamdi Azikiwe University Awka, undertaking a study on the application of collaborative learning strategy in students learning of mathematics. She went on saying that sequel to her explanation to their principal the day she visited their schools, she would like them to help her in the effective implementation of the techniques to see if they would effect students' academic performance in mathematics.

The meaning of collaborative learning Strategy was explained thus, learning process whereby students in heterogeneous groups of not more than five, come together for the purpose of learning and helping each other to understand the subject better. She also highlighted the values of collaborative learning strategy; such as, enabling students to work hard selflessly not only to improve their achievement in mathematics but to help others succeed too among others. Different techniques of collaborative learning strategy were enumerated; think pair

share, round table structure, team game tournament, students team achievement division, number heads together, Jigsaw among others. For the purpose of this study, concentration was on JS, STAD and NHT. With the use of simple random sampling, the counsellors picked a technique that was applicable to their schools. The techniques (STAD, JS, NHT) were numbered school 1 – 3 accordingly, whichever one a counsellor picked, the school was tagged that number: CSS Agulu Awka – STAD, ECSS Awka – NHT, CCSS Awka – Jigsaw.

The researcher explained the steps for the application of the three techniques. After the assistants were asked to go home and deliberate on what had been discussed and come back in the next two days. Since the seminar lasted for a longer period, she provided snacks and malt for the participants.

The Research Assistant's Activities

They contributed during the seminar. They asked questions for clarification and answered the questions that were posed to them by the researcher.

2nd Day

After exchanging pleasantries with the research assistants, the researcher went straight to rehearse what was discussed the other day and called for questions. There was micro group activities to practice on the application of the collaborative learning strategy in the learning of mathematics (using fellow research assistants).

Necessary class climate and team building techniques were spelt out thus; students should not be allowed to move about aimlessly during the learning period.

They should talk in turn and should not shout or make embarrassing noise on any member making contributions among others.

Respective counsellors chose two days each week for the preparatory learning exercise – Mondays and Wednesdays/Tuesdays and Thursdays.

The Guidance Counsellor in Community Secondary School Okpuno (CSS Okpuno) who helped out in control group was instructed to encourage her students to study hard during the preparatory classes. She should allow the students to use any conventional method convenient to them. The learning periods was guided by common time table and scheme of work.

During the training of research assistants, the activities of the four mathematics teachers were spelt out too:

- helping in administering the pretest posttest achievement test,
- marking the pretest, posttest achievement test,
- recording the scores and handing them over to the researcher,
- helping out when the students approach him for clarification on any difficult mathematics problem.

Experimental Procedure

The treatment lasted for six weeks, two periods of one hour each (3pm – 4pm). The treatment periods were accommodated within the school preparatory class periods taking place every Monday and Wednesday/Tuesday and Thursday after school as the case may be. The treatment looked at the application of collaborative learning strategy (STAD, JS and NHT) in the learning of SS I

Mathematics. Since the learning periods affected the private time of the students, the researcher gave the students snacks and pure water to sustain them.

Skills: Set induction (creating rapport)

Listening, communication, questioning, elaboration, modelling, discussion, group activities…

Treatment Materials: Research assistants, students, textbooks, chalkboard, chalk, mathematical sets, students mathematics notebook, internet, library.

Recipients: SS I students

Duration: Six weeks

Mode of Treatment: Group Activities.

Treatment Procedure (for all the experimental schools)

Week I

Period I

Date: 15-05-13/16-05-13

Time: 1hr

Topic: General introduction and group counselling on collaborative learning strategy.

Introduction

The researcher introduced the preparatory class on mathematics group counselling in all the schools. On entering the class in company of the school counsellor, they exchanged greetings with the students. The school counsellor

introduced the researcher and told the students to feel relaxed that the visitor is also a guidance counsellor. That she has come to help them tackle some of these problems concerning mathematics which they usually bring to her office. After the introduction, she invited the researcher to talk to the students. The researcher greeted the students once more and introduced herself. She cracked some jokes with the student to relax them more.

The researcher inquired about the students' general impression concerning mathematics and asked them to mention the importance of mathematics in the education system. She then highlighted the reason why students must pay attention to mathemtics. The researcher pleaded with the students to cooperate with her and their school counsellor to enable them carry out the mission successfully She announced to the students that the essence of her coming to their school is to introduce a learning strategy which their school counsellor would help them to apply in their learning of mathematics, and the strategy is known as collaborative learning strategy.

Meaning of Collaborative Learning Strategy

The meaning of collaborative learning strategy was explained to the students (A learning process by which students are shared in groups of not more than five for effective learning. In the group, each member should work hard to learn and help the other members to learn too. Different types of collaborative learning strategy were enumerated.

After explaining to them, she enumerated and explained the values of collaborative learning strategy thus: collaborative learning strategy helps students to:

- avoid cram work,
- understand clearly the material to be learnt,
- facilitate retaining and retrieval of the material learnt,
- learn in a more friendly atmosphere where they are free to ask questions, make contributions and constructive criticisms without being cajoled.
- ,the person who elaborates for others will gain more by internalizing and personalizing the knowledge.

  enables students to enter mathematics examination comfortably without phobia of any kind.

The particular learning technique (STAD/JS/NHT) for the school was announced.

Students' Activities: The students paid absolute attention. They participated fully, asking and answering questions.

Expectations from the Students: The students spelt out their dos and don'ts during the learning sessions such as,

- no noise making,
- every member must participate fully,
- every member's opinion must be respected,
- no lateness,
- no absenteeism among others.

Treatment Procedure for ECSS Awka

Technique: Number Heads Together

Week: I

Period: II

Date: 17-4-13

Time: Ihr.

WK: I

Period : II

Topic: Introducing the Techniques (STAD, JS, NHT)

Group Counseling

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	18-04-13	17-04-13	17-04-13
Technique	STAD	JS	NHT
Meaning	The researcher on entering the classroom with the research assistant exchanged greetings and pleasantries with the students. The researcher rehearsed what was done with the students previously on collaborative learning	The researcher and the research assistant on entering the classroom exchanged greetings and pleasantries with the students. The researcher rehearsed what was discussed with the students on collaborative learning strategy. She	The researcher and the research assistant on entering the class exchanged short greetings and pleasantries with the students. The previous discussion on collaborative learning strategy was rehearsed with the students and the day's topic, (NHT)

	strategy. She introduced the day's activities, encouraging the students to adopt STAD technique in their learning of Mathematics. **Meaning of STAD**: Student Team Achievement Division technique is a form of collaborative learning strategy whereby students are shared into groups of four (not more than 5) members for the purpose of learning. The groups are usually heterogeneous in nature (mixed intelligence, gender and ethnicity). A topic is thrown open for every group to learn. Members make use of every reference resource materials available to	then made a general introduction of the day's activities (Jigsaw). **Meaning of Jigsaw**: The researcher explained the meaning of Jigsaw collaborative learning strategy to the students: Jigsaw collaborative learning strategy is a process of learning by which students work in groups of 4 – 6 to become 'experts' on a particular topic which is based on overall theme or unit of study (Hedeen 2003).Using this structure students are responsible for teaching each other the material. A unit of work is divided into four expert areas and each student in the team is assigned one	introduced. **Meaning of Number Heads Together:** The researcher explained thus: NHT is a learning technique whereby students work in a four-man team to learn a particular material. They are expected to really "put their heads together" to ensure that all learnt the material.. The students are shared in groups and numbered off 1 – 4. They coach each other on the material to be learnt. The coordinator poses a question and calls a number . Only students with that number is eligible to answer and earn points for their team .NHT builds on accountability and positive interdependence. This is

	master the problem and teach it to other members in the group. After 40mins, the students retire to the normal class position for individual quiz. In this case individuals' gain in achievement is a credit to the group. Each student would be given a work sheet to assess others' contributions during team works. Members not only concerned themselves with learning the material, they would try hard to see that other members learnt the material too to enable the group earn group marks and reward. After 40mins, the members participate in individual quiz where none would	piece. Experts from the team meet together at tables to discuss their expert segments. Students then return to their teams to take turns teaching each other. . A quiz is then given to the students. Jigsaw material refers to any material in which each student in a team receives only a piece of the material that is to be learnt so that the student must rely on other members of the team to learn all the material. Each member is expected to participate actively in the research efforts using different resources to become 'experts' in his own particular topic.. By the end of the unit, each is	done sequentially with numbers or students with the number. Any correct answer attracts scores for the group. By the end of the learning session, the champion group would be announced and commended. By implication each member must learn and master the topic for none knows which number that would be called up. It is also the duty of the group members to make sure all in the group learnt the material so as to earn marks for the group. Individual quiz follows the learning session. **Practice**: The students were then shared in groups and they demonstrated what was explained. **Pre-test**: After the micro

	help the other. The quiz would be marked and scores compiled by the mathematics teacher.. Teams that meet with agreed criteria/standard might earn certificate or any other reward. Each week, three winning groups must emerge. **Importance of STAD:** The values of STAD in the learning of mathematics were spelt out to the students thus: It encourages team spirit in learning, each member caring for the others' success. Students would feel relaxed to ask questions and make contributions and learn how to teach others. STAD encourages students to reach out in	accountable for the information shared throughout the class. In Jigsaw, as each member is important in a group so is each piece of the topic in understanding the whole topic. **Importance of Jigsaw**: The researcher explained what the students would gain in using Jigsaw as a learning strategy. Such as; it encourages listening, engagement and empathy by giving each member of the group an essential part to play in the academic activity. It emphasizes on cooperation and shared responsibility and enables students to learn how to search for information in solving	presentation, the students were prepared for the pretest achievement test. Then the researcher with the help of the research assistants administered pretest to the students to enable her ascertain the students' level of knowledge. This also guided her in grouping the students to make sure students with different abilities are placed in a groups.. The test was marked by the mathematics teacher and marks handed over to the researcher. **Students' Activities**: The students paid attention to the counsellor's explanations, made their own contributions. They asked and answered questions for clarification.

	solving difficult academic problems. **Pre-Test Administration**: Pre test achievement test was administered to the students with the help of research assistants (counsellor and mathematics teacher) to enable the researcher determine their achievement level. The scores facilitated also in grouping the students. The students' mathematics teacher marked the test and submitted the scores to the researcher. **Research Assistant's Activities:** Assisted the researcher in introducing the collaborative learning strategy to the students.	problems in academics. The students added their own points: It enables students to be experts in their own segment of the topic and helps one to learn how to teach others. Students were allowed to ask questions for more clarifications. There was mini demonstration on the use of Jigsaw by students. **Pre-test Administration**: Pre-test was administered to the students to enable the researcher determine their achievement level. The mathematics teacher of the class helped in marking the pretest. The scores were handed over to the researcher. **Students' Activities**:	Students participated in the mini demonstration, and took the pre-test achievement test.

	She helped in maintaining order in the class. Also, she helped in the administration of pre-test achievement test to students. **Student's Activities:** Students paid attention to the explanations, made their contributions and took the pre-test achievement test. There was mini demonstration on application of STAD in the learning process.	The students participated actively in the class. They did the pretest as was directed by the researcher.	

Week II

No of Periods: 2

Time: 1hr

Topic: Direct and Inverse Variation

Group Goals: To-identify direct and inverse variation.

- Determine the constant of the variation.
- Determining relationship between the variation (either direct or inverse variation).
- Solve problems involving direct and inverse variation.

Reference Sources: SS I General Mathematics textbook, mathematics teacher, library, peers, internet, class mathematics note book.

Period I

Topic: Direct Variation

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	23-04-13	22-04-13	22-04-13
Technique	STAD	JS	NHT
Student Activity	Students in five-man heterogeneous team were allowed 40 mins to discuss and solve the problems in their groups. Members engage themselves in an intensive collaborative research to make sure that every member understood the topic. They made use of resources available in solving, checking and drilling each other. They	Students were shared into mother groups of four each with the help of the research assistant. The topic for discussion was also shared into four segments; each student assigned one piece. Then students with the same piece came together to form expert groups. They worked hard to learn this assigned material, and how to teach others in their	After exchanging pleasantries with the research assistant, they were shared in groups of not more than 4 and numbered off 1 – 4. The students selected their coordinator and secretary/recorder for the session. The students utilized 20mins to learn the material/topic. They really "put their heads together" not only to learn the material individually but to

	also worked hard to ensure that their team members earn the enhancement score to merit group award. Each student also worked on the worksheet given to him which was submitted later. Students were eager to contribute and learn from others. Those who understood better coached other group members. They later took the general quiz by the end of the learning session and submitted their worksheet.	expert groups. With the result that when they went back to their mother group after 20mins they became "more knowledgeable other" according to Vygotsky (1978) in their assigned piece and taught the rest of the group members. Every member paid absolute attention to what others were presenting, asked and answered questions where need be. After another 20 mins of presentation and further learning, the students were given general quiz where none helped the other.	help others learn too. The more knowledgeable members of the groups coached others but all joined together in search of useful information to the problem solution. The group members were seen inviting others from another group who understood the topic better to assist them. Some sent their members to learn from other groups and went back to teach the rest. It was observed too that every member participated actively because none knew who will be called up to represent the group. In the group they also learnt how to teach others. When time was up; the coordinator ordered the students to "stop" "come together". All the groups

			disbanded and joined the entire class. The coordinator called out numbers for students to come up and teach others what they learnt. The recorder shared the groups according to the agreed performance criteria. The activity took another 15 – 20 mins. Students also put down salient points raised by their fellow students during interaction. They later took class quiz.

Research Assistant's Activity

The research assistant helped in sharing the students in groups. She made sure the students did their assignments and corrections. She also floated from one group to the other monitoring students' activities to make sure there were no slackers or lords of the groups. The research assistant did commend and correct students' activities.

Evaluation: The students evaluated the group activities and took decisions on how to move on. They also picked their take home assignment.

Period II

Topic: Inverse Variation

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	25-04-13	24-04-13	24-04-13
Technique	STAD	JS	NHT
Student Activity	Students were shared into new groups. They rehearsed the take home assignment in such a way that all the students could conveniently solve some problems in the exercise by themselves. Students exhausted all available reference sources. Each contributed his quota to help all in the group to learn.	Students maintained their former groups. They tried to relax themselves for five minutes narrating short stories. The previous learning assignment was rehearsed. Topic segments were shared in groups and the expert group emerged. Members participated fully in gathering information and ideas. They discussed, solved some exercises and	Students exchanged greetings and pleasantries among themselves. They discussed home assignment and effected corrections. Coordinators and recorders were appointed before they moved to their groups' discussions. Groups were given 20mins for the interactive learning. Student actively participated in discussions and problem solving, took down important points. Those who understood the

		brainstormed on how to teach the rest of the mother group. By the end of 20mins, they expert group members joined their original group for peer teaching on the learnt segment. Students paid absolute attention, made some contributions, asked and answered questions.	topic better were seen teaching others. When time was up, the students were called back for class discussing and further learning. Numbers were called up to represent their groups and scores charted on chalkboard. The scores were summarized and the winning team (group 5) was commended.

Research Assistant's Activity

She made sure the students got relaxed and ready to study. She helped in sharing the students in groups. The research assistant ensured that the students kept to task, monitored their activities and made her submission.

Evaluation: Students submitted their worksheet to the research assistant. They constructively criticized their members' activities and suggested ways of moving forward.

Week III

No. of Periods: 2

Time: 1hr

Group Goals To:

- identify joint and partial variations
- solve problems involving joint and partial variations.

Reference Sources: SSI General Mathematics textbook, mathematics teacher, library, peers, internet, class note on mathematics.

Period I

Topic: Joint Variation

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	30-04-13	29-04-13	29-04-13
Technique	STAD	JS	NHT
Student Activity	In groups, student went through the assignments given to them the previous day. Difficulties and shortfalls were dictated and corrected. New topic for the day was introduced and they all worked hard to learn.	Students convened in their groups, shared the topic into segments and assigned them to individual members. Those with similar segments formed expert groups to learn their piece of the topic. They	The students greeted the research assistant as she entered the class. There was brief assessment on their previous activities so far and rehearsal of the take home assignment. This was followed by introduction of new topic. Students elected

	Students were observed teaching each other on how best to solve exercises in joint variation. By the end of 40mins. they were exposed to individual quiz.	worked hard for 20mins to learn the material and helped each other to learn too. In the mother groups, students acted as "more knowledgeable others" to others in their expert topics. Absolute participation was observed among the students and they were able to solve some problems in joint variation.	their coordinator and recorder for the session. They were also shared in groups and numbered off 1 – 4. In the groups, students studied collaboratively for 20mins exploring the resource materials to learn how to solve problems in joint variation. When time was up, the coordinator called the students back to their normal class room for class presentation; after which they were exposed to individual quiz.

Research Assistant's Activity

She was there for the students, monitored their activities and directed accordingly.

Evaluation: Students submitted their worksheets and picked their take home assignment. There was discussions on members' participation and what they

gained so far using collaborative learning strategy. Suggestions were made on how to improve.

Period II

Topic: Partial Variation

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	02-05-13	01-05-13	01-05-13
Technique	STAD	JS	NHT
Student Activity	There was exchange of greetings and pleasantries after which they went through the take home assignment in their respective groups. The new topic (partial variation) was introduced. All the members participated actively, discussed, explained and solved mathematics problem in joint variation for 40 mins. Members were sent to other groups to learn	Students went through the carry home assignment and helped members with difficulties. The days topic was shared to individual members. The students with similar segments came together to study. They made use of the reference sources to solve their problems, presented their piece to the group and listened to gain from others and jotted down important	Students were given five minutes to interact with each other on the joint variation studied previously and helped each other more to understand better. The students also discussed the new topic (partial variation). Reference resources were consulted in handling the topic. Group members ensured that all mastered the topic by teaching those who were weak in one aspect or the other. When time was up,

	more on the topic and explain later to the entire group. They were later given quiz and scores summated and compared. Groups (6 & 8) that met average enhancement score were commended.	facts. By the end of 20mins, students went back to their original groups to teach and learn from others. After this, they faced individual quiz.	the coordinator posed questions and called up numbers (students) to answer. The recorder scored accordingly after which individual quiz was given.

Research Assistant's Activity

Created relaxed atmosphere and encouraged students to contribute in all activities and made sure all kept to task. She monitored the groups' activities and tried to help any group experiencing difficulties by referring them to other groups or mathematics teacher.

Evaluation:

Students constructively evaluated the groups activities and took decisions.

Week IV

No. of Periods: 2

Time: 1hr

Topic: Geometrical Construction

Group Goals: To, Draw and Measure straight lines

- Bisect line segments

- Bisect angles
- Construct special angles with a ruler and a pair of compasses.

Reference Sources: SS I General Mathematics, textbook, mathematics teachers, library, peers, internet, class mathematics note book.

Period I

Topic: Draw and Measure Straight Lines, Bisect line segments

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	07-05-13	06-05-13	06-05-13
Technique	STAD	JS	NHT
Student Activity	The students revised the take home assignment to make sure all could conveniently solve exercises on partial variation. They now concentrated on the new topic (drawing and measuring straight lines). It was full of practicals and all were very active in their groups. The students engaged themselves in intensive	The previous assignment was discussed by students after which they were shared into groups and the topic segments distributed. Students with similar segments were drawing and measuring straight lines. They even learnt how to teach it to others. During interaction in the mother group, each student taught his own piece and	It was observed that students were happy with the learning exercise. The topic (drawing and measuring of straight lines) was introduced. The coordinator and recorder were selected. The peer learning and teaching lasted for 40mins. Students were seen carrying out the practical exercise, practicing and teaching others to learn too. Each

	collaborative learning activities explaining and drilling each other. They were later exposed to quiz, enhancement scores worked out. Groups 6 and 8 were commended.	paid attention when others were presenting. They asked questions for clarifications and made contributions.	student tried out the drawing of straight line severally and were prepared for individual quiz.

Research Assistant's Activity

Welcomed the students for another weeks learning exercise, created rapport and encouraged them to continue.

Evaluation: Students participation was discussed and groups commended for active involvement .

Period II

Topic: Geometrical Construction: Bisect Angles, Construct special angles with a ruler and a pair of compasses

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	08-05-13	08-05-13	08-05-13
Technique	STAD	JS	NHT
Student Activities	In their groups, they went through the take home assignment. The group	Students retired to their groups. Discussed the assignment given to	There was exchange of pleasantries. Students in their groups rehearsed the

	members engaged themselves in intensive collaborative study on the topic for the day using the reference sources, solving problems, checking and drilling each other for 40mins. Students were late exposed to individual quiz to assess their understanding of the material learnt.	them the previous day. Pieces of the day's topic was allotted to members and expert groups were seen practicing the construction. They brainstormed on how to teach their segments to other members. Students were later seen in their mother groups drilling others what they learnt. After the agreed time, they were exposed to individual quiz.	take home assignments. They practiced how to construct some angles. Members were teaching each other the best approach to the construction.

Research Assistant's Activity

Helped in sharing the students in groups, monitored the practice and drill by groups and helped out where she could.

Evaluation: Students haven observed each other's perform, made some criticisms and took decisions.

Week V

No. of Periods: 2

Time: 1hr each

Topic: Construction of Triangles

Group Goals: To learn how to:

- Sketch and represent the information given in the problem construction of a triangle.
- Construct triangles given sufficient information.

Reference Sources: SSI General Mathematics, mathematics teachers, library, peers, internet, and class note book on mathematics.

Period I

Topic: Construction of Triangles: Sketch and represent the information given in the problem construction of a triangle

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	08-05-13	08-05-13	08-05-13
Technique	STAD	JS	NHT
Student Activity	Students cracked jokes and shook hand with each other. They moved to their respective groups, discussed and did corrections on the previous assignment.	Rapport was created. Difficult experiences concerning the topics handled so far were shared, discussed and solution met. Students shared themselves into	After creating rapport, students went to their respective groups, numbered off the members and went into the day's business. They participated in the drill and practice,

	Members practiced and drilled each other on the topic. Those who understood better coached the others. They sought for a better way to tackle the problem for the interest of the entire students. Some members went to another group to learn the construction and went back to educate others. Quiz was given to the students which was marked with the help of mathematics teacher and gain in enhancement score recorded.	groups and segmented topics shared to individual members in the groups. This was assigned through random sampling (picking without replacement). As usual students retired to their groups for learning and mastering. They all participated in the drill and practice. Both in expert group and mother group. They later took quiz and picked take home assignment.	teaching and learning from others thereby preparing each other for the quiz.

Research Assistant's Activity

She monitored the group and encouraged members to move on.

Evaluation: Students evaluated their group activities.

Period II

Topic: Construction of Triangles given sufficient information (sizes and angles)

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	16-05-13	15-05-13	15-05-13
Technique	STAD	JS	NHT
Student Activity	There was initial rapport among students. The previous topic on construction was looked into to ensure that all the students were carried along. The students drew, demonstrated and practiced the construction topic for the day. Students studied hard to learn the construction. On more difficult construction exercise, some group members went to their mathematics teacher, learnt the construction	Students revised their take home assignment and helped the weak ones to learn too. They went to their various groups to learn the new topic. The topic was divided into segments and shared to the individual members in the groups. From the segmented topic assigned, students formed expert groups to learn, master and get ready to teach others in the original group. Students contributed	Students selected their coordinator and recorder. The coordinator numbered off the students and asked them to go back to their groups. Topic of the day was announced. In groups students practiced construction of the given triangles and got ready for individual quiz.

	and reported back to the group. Quiz was given to them and the enhancement score calculated.	actively during discussions and solving of mathematical problems in their groups. They were able to teach the segments to others.	

Research Assistant's Activity

The research assistant floated from one group to the other monitoring students' participation.

Evaluation

There was evaluation of group activities. Members were commended for their active participation while slackers were reprimanded.

Week VI

No of Periods: 2

Time: 50mins each

Group Goals: To review what was done for the five weeks.

- Take post test achievement test.

Reference Sources: SS I General Mathematics textbook, mathematics teacher, peers, library, internet, class mathematics notebook.

Period I

Topic: Revision

School	CSS Agulu, Awka	CCSS Awka	ECSS Awka
Date	21-05-13	20-05-13	20-05-13
Technique	STAD	JS	NHT
Student Activity	In the class students exchanged greetings with each other, retired to their groups for revision. First the previous assignment was revised followed by revision of all the topics studied for the past five weeks. Members ensured that each and every group member mastered all they have learnt and got ready for the post test.	Students exchanged pleasantries with each other, revised the carry home assignment and later went to their respective groups. The topics studied for the past five weeks were shared and allotted to different groups as segments to be revised. After, respective groups posed questions based on the area they revised for other group members to answer. This was scored and the winning team rewarded.	Students exchanged greetings and deliberated on the previous assignment and given to them. They retired to their groups to revise all they have been learning previously for past five weeks. When time was up, they rallied together in their former position to participate in general discussion and answering of revision questions.

Research Assistant's Activity

She commended the students for their participation throughout the learning period and encouraged them to continue applying collaborative learning strategy (NHT, STAD, JS) in their learning of mathematics and other subjects.

Evaluation was done on group interaction and individual contributions. Students were urged to get ready for the post test coming up during the next learning period.

Period II

Date: 22-05-13 and 23-05-13

Post Test for all the Schools

The research assistant created rapport with the students. She asked them to feel relaxed and take the incoming test as honestly as ever. They tests were just to find out how far they have learnt the topics. Post-test was administered to the students.

Research Assistant's Activities: She thanked the students for their wonderful cooperation and encouraged them to go through what they have done so far and get ready for post test achievement test.

Students' Activities: They revised together all they have learnt for five weeks and used the opportunity to clarify doubts.

Activities of Control Group (CSS Okpuno)

The research assistant explained to the students that they would start learning sessions in Mathematics on Tuesdays and Thursdays to enable them tackle their mathematics problems and be able to finish their mathematics syllabus on time. The learning session would last one hour (3pm – 4pm) each time. The students in control group were allowed to learn under the normal conventional way of learning. They sat individually studying independently. The scheme or topics of learning was the same with the experimental group. The students were allowed to ask each other questions if they desire but their interaction was limited.

By the end of each learning session, they took individual quiz and were given take home assignment just like those students in the experimental group. The posttest achievement test was administered to them.

Methods of Data Analysis

The instruments (Teacher Made Achievement Test - TMAT) used for data collection were marked and the summated scores collated. The mean of pretest and posttest summated scores were calculated and the achievement mean gained difference used in interpreting and answering the research questions. Therefore, any achievement mean gained score difference that has 20 points above the pretest mean score is considered effective.

Analysis of Covariance (ANCOVA) was used in testing the hypotheses.

Control of Extraneous Variables

Extraneous variables are independent variables which could exert some influences over the dependent variables but are not themselves studied (Nworgu 2006). The researcher tried to identify the extraneous variables and controlled them. The variables are thus:

Class Interactive Effect

This occurs where students interact with each other (both experimental and control groups) after their group session. This may mar the study because those in the control group might indirectly receive treatment.

To control class interactive effect, among experimental groups and between control and experimental groups, separate schools were used for different learning techniques (STAD, JS, NHT) and control group. None was aware of what was happening in the other school. Besides the study was conducted during evening compulsory preparatory classes when all students were busy in their own class studying. Teachers on duty were in every other class monitoring the students' activities.

School Location Effect

School location effect occurs where some schools are located in the rural and urban areas. To avert the effect, schools in Awka metropolis whose cultural practices are almost the same were used. Therefore the students were exposed to almost the same learning conditions. Also, only co-educational secondary schools

with professional counselors were used to ensure that all got the professional touch needed.

Effect of Pretest and Posttest

This refers to test consciousness among the students. If the duration between the pretest and posttest is close, the respondent may merely transfer the ideas they had in the previous test to the new one especially where the test deals with recall only. The treatment lasted for six weeks of two prep periods a week. Therefore the gap between the pretest and posttest was six weeks. It was assumed that by the end of the treatment the effect of the treatment must have materialized hence the pretest by the first week and post test by the sixth week. The gap between the administering of pre-test and that of post test was long enough to avert any effect of pretest on posttest. Also the items were rearranged and renumbered before readministering the posttest to avoid test consciousness. Also used is ANCOVA which is effective for controlling extraneous variables.

Experimental Mortality Effect

Experimental Mortality is likely to occur in a study like this especially where the study lasted unnecessarily for a long period. Death of the subjects may contribute but most threatening factors are dropping of the respondents or transfer of important actors in the study. Experimental mortality may occur too as a result of longetivity of the study, lack of adequate motivation or demands of the experiment.

To avoid the occurrence of internal factors, different reinforcement procedures were employed. Group activities made the lesson interesting and

sensitized students to continue. The students were encouraged individually and in groups. The most active ones were commended, by praising them and asking others to clap for them. They were also used as more knowledgeable others in the group. The weaker ones were encouraged to continue, observe and emulate the active ones. Snacks were randomly given to students during the period of study to avoid their being tired or hungry when it lasted for a longer period.

Teacher Quality Effect

The extraneous variable might occur where different teachers with different method and qualifications handle the students' mathematics.

Teacher quality effect/variable was controlled by using four guidance counsellors with the same qualifications, similar experience and potentials. The Mathematics teachers came together to construct pre and post Achievement tests to be used.The research assistants (School Counsellors) were trained commonly in the use of STAD, NHT and JS collaborative learning strategy by an expert (the researcher). They were also provided with detailed instruction for conducting learning activities in both control and experimental groups. Incidentally, the only difference was that, the students in collaborative learning class completed learning activities in small heterogeneous groups; while those in the control group completed theirs individually under the normal class prep environment. Furthermore student were heterogeneous groups where all bring in ideas on how to solve their problems. Their contributions in groups took care of the teacher quality effect.

Hawthorne Effect

This situation may mar the progress of any experimental research if not controlled. According to Ali (1996) Hawthrone effect occurs when the students respond or react to the newness of the experimental treatment itself. If the students suspect that they are being used for a particular study, it may lead to faking their behaviours (Nworgu, 2006). They may resent any treatment, make fun of it. feel rejected, inferior or superior to others. As a result the researcher will not get the true result.

The variable was controlled by using separate schools with uniform characteristics. Research assistants (school guidance counsellor and mathematics teachers) who were familiar with the students were trained to do most of the treatment. The treatment took place under the normal school programme. The idea of an experimental exercise going on in the school was not exposed to the students. They were convinced that the school counsellor and the researcher who also was a guidance counsellor were there just to help them improve their performance in mathematics.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

In this chapter, the data collected from the field for this study were analyzed and the summaries were presented in tables to highlight the findings. The presentation was sequential starting with the answer to the research questions and then the testing of the null hypotheses.

Research Question 1

What is the effect of Students' Team Achievement Division Learning Technique on academic achievement of students in mathematics?

Table 1: Pretest and Posttest Mathematics Mean Scores of Students who Received STAD and those in the Control Group

Source of Variation	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
STAD	47	16.87	43.45	26.58	Effective
Control Group	34	19.76	29.76	10.00	

Table 1 shows pretest mean score of 16.87 and posttest mean score of 43.45 with gained mean 26.58 for the students treated with the STAD learning technique as against pretest mean score of 19.76 and posttest mean score of 29.76 with gained mean of 10.00 for the students in the control group. Therefore, Students' Team Achievement Division learning technique aspect of collaborative learning strategy is very effective in enhancing academic achievement of students in mathematics.

Research Question 2

What is the effect of Jigsaw learning technique on enhancing academic achievement of students in mathematics?

Table 2: Pretest and Posttest Mathematics Mean Scores of Students who Received Jigsaw and those in the Control Group

Source of Variation	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
Jigsaw	47	20.43	45.00	25.57	Effective
Control Group	34	19.76	29.76	10.00	

Table 2 shows pretest mean score of 20.43 and posttest mean score of 45.00 with gained mean 25.57 for the students treated with the Jigsaw learning technique as against pretest mean score of 19.76 and posttest mean score of 29.76 with gained mean of 10.00 for the students in the control group. Therefore, jigsaw learning technique aspect of collaborative learning strategy is very effective in enhancing academic achievement of students in mathematics.

Research Question 3

What is the effect of Number Heads Together learning technique on academic achievement of students in mathematics?

Table 3: Pretest and Posttest Mathematics Mean Scores of Students who Received NHT and those in the Control Group

Source of Variation	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
NHT	45	18.29	41.84	23.55	Effective
Control Group	34	19.76	29.76	10.00	

Table 3 shows pretest mean score of 18.29 and posttest mean score of 41.84 with gained mean 23.55 for the students treated with the NHT learning technique as against pretest mean score of 19.76 and posttest mean score of 29.76 with gained mean of 10.00 for the students in the control group. Therefore, Number Heads Together learning technique aspect of collaborative learning strategy is moderately effective in enhancing academic achievement of students in mathematics.

Research Question 4

Which of these learning techniques (STAD, Jigsaw and NHT) of collaborative learning strategy is more effective in enhancing students' academic achievements in mathematics?

Table 4: Pretest and Posttest Mathematics Mean Scores of Students who Received STAD, Jigsaw and NHT

Source of Variation	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
STAD	47	16.87	43.45	26.58	Most Effective
Jigsaw	47	20.43	45.00	25.57	
NHT	45	18.29	41.84	23.55	

Table 4 indicates that with gained mean of 26.58, students who studied using STAD performed better than those who used Jigsaw who had a gained mean of 25.57 and then those who used NHT who gained mean of 23.55.

Hypothesis 1

There is no significant difference in the mean scores of students exposed to STAD learning technique aspect of collaborative learning strategy and those who received ordinary counselling in enhancing academic achievement of students in mathematics.

Table 5: ANCOVA of the mean scores of students treated with STAD and those in the control group

Source of Variation	SS	df	MS	Cal.F	Crit.F	P ≥ 0.05
Corrected Model	4649.425	2	2324.712			
Intercept	7498.936	1	7498.936			
Pretest Scores	340.103	1	340.103			
Treatment Models	4646.304	1	4646.304	91.21	3.96	S
Error	4533.825	89	50.942			
Residual	133435.000	92				
Corrected Total	9183.250	91				

In Table 5, it was observed that at 0.05 level of significance, 1df numerator and 92df denominator, the calculated F91.21 is greater than the critical F3.96. Hence the null hypothesis I was rejected. Therefore, Students' Team Achievement Division learning technique aspect of collaborative learning strategy is significant in enhancing academic achievement of students in mathematics.

Hypothesis 2

There is no significant difference in the mean scores of students exposed to Jigsaw learning technique aspect of collaborative learning strategy and those who received ordinary counseling in enhancing academic achievement of students in mathematics.

Table 6: ANCOVA of the mean scores of students treated with Jigsaw and those in the control group

Source of Variation	SS	df	MS	Cal.F	Crit.F	P ≥ 0.05
Corrected Model	5715.330	2	2857.665			
Intercept	5871.877	1	5871.877			
Pretest Scores	372.815	1	372.815			
Treatment Models	5154.267	1	5154.267	110.29	3.96	S
Error	4159.496	89	46.736			
Residual	139550.000	92				
Corrected Total	9874.829	91				

In Table 6, it was observed that at 0.05 level of significance, 1df numerator and 92df denominator, the calculated F110.29 is greater than the critical F3.96. So, the second hypothesis was rejected. Therefore, Jigsaw learning technique aspect of collaborative learning strategy is significant in enhancing academic achievement of students in mathematics.

Hypothesis 3

There is no significant difference in the mean scores of students exposed to NHT learning technique aspect of collaborative learning strategy and those who received ordinary counselling in enhancing academic achievement of students in mathematics.

Table 7: ANCOVA of the mean scores of students treated with NHT and those in the control group

Source of Variation	SS	df	MS	Cal.F	Crit.F	P ≥ 0.05
Corrected Model	3515.185	2	1757.593			
Intercept	6597.532	1	6597.532			
Pretest Scores	227.007	1	227.007			
Treatment Models	3459.330	1	3459.330	60.76	3.96	S
Error	4953.215	87	56.934			
Residual	123816.000	90				
Corrected Total	8468.400	89				

Table 7 reveals that at 0.05 level of significance, 1df numerator and 90df denominator, the calculated F60.76 is greater than the critical F3.96. Therefore, null hypothesis 3 was rejected. So, NHT learning technique aspect of collaborative learning strategy is significant in enhancing academic achievement of students in mathematics.

Hypothesis 4

There is no significant difference in the mean scores of students exposed to STAD, Jigsaw and NHT learning techniques of collaborative learning strategy in enhancing academic achievement of students in mathematics.

Table 8: ANCOVA of the mean scores of students treated with STAD, Jigsaw and NHT

Source of Variation	SS	df	MS	Cal.F	Crit.F	P ≥ 0.05
Corrected Model	234.822	3	78.274			
Intercept	25196.020	1	25196.020			
Pretest Scores	5.904	1	5904.088			
Treatment Models	234.782	2	117.391	1.740	2.60	NS
Error	9107.624	135	67.464			
Residual	271800.000	139				
Corrected Total	9342.446	138				

Table 8 shows that at 0.05 level of significance, 2df numerator and 139df denominator, the calculated F1.74 is less than the critical F2.60. Hence the fourth hypothesis was accepted. Therefore, STAD, Jigsaw and NHT learning techniques of collaborative learning strategy do not differ significantly in enhancing academic achievement of students in mathematics.

Hypothesis 5

There is no significant difference in the mean scores of students exposed to STAD and Jigsaw learning techniques of collaborative learning strategy in enhancing academic achievement of students in mathematics.

Table 9: ANCOVA of the mean scores of students treated with STAD and Jigsaw

Source of Variation	SS	df	MS	Cal.F	Crit.F	P ≥ 0.05
Corrected Model	56.992	2	28.496			
Intercept	16889.774	1	16889.774			
Pretest Scores	.301	1	.301			
Treatment Models	49.825	1	49.825	0.79	3.96	NS
Error	5757.316	91	63.267			
Residual	189651.000	94				
Corrected Total	5814.309	93				

Table 9 shows that at 0.05 level of significance, 1df numerator and 91df denominator, the calculated F0.79 is less than the critical F 3.96. Hence, the 5th hypothesis was accepted. Therefore, STAD and Jigsaw learning techniques of collaborative learning strategy do not differ significantly in enhancing academic achievement of students in mathematics.

Hypothesis 6

There is no significant difference in the mean scores of students exposed to STAD and NHT learning techniques of collaborative learning strategy in enhancing academic achievement of students in mathematics.

Table 10: ANCOVA of the mean scores of students treated with STAD and NHT

Source of Variation	SS	df	MS	Cal.F	Crit.F	P ≥ 0.05
Corrected Model	70.499	2	35.249			
Intercept	18371.624	1	18371.624			
Pretest Scores	11.473		111.473			
Treatment	52.329	1	52.329	0.73	3.96	NS
Models						
Error	6394.055	89	71.843			
Residual	173917.000	92				
Corrected Total	6464.554	91				

Table 10 indicates that at 0.05 level of significance, 1df numerator and 92df denominator, the calculated F0.73 is less than the critical F3.96. Therefore, hypothesis 6 was accepted. Hence, STAD and NHT learning techniques of collaborative learning strategy do not differ significantly in enhancing academic achievement of students in mathematics.

Hypothesis 7

There is no significant difference in the mean scores of students exposed to Jigsaw and NHT learning techniques of collaborative learning strategy in enhancing academic achievement of students in mathematics.

Table 11: ANCOVA of the mean scores of students treated with Jigsaw and NHT

Source of Variation	SS	df	MS	Cal.F	Crit.F	P ≤ 0.05
Corrected Model	238.818	2	119.409			
Intercept	15313.111	1	15313.111			
Pretest Scores	9.903	1	9.903			
Treatment Models	238.670	1	238.670	3.51	3.96	NS
Error	6054.008	89	68.023			
Residual	180032.000	92				
Corrected Total	6292.826	91				

Table 11 shows that at 0.05 level of significance, 1df numerator and 92df denominator, the calculated F3.51 is less than the critical F 3.96. So, hypothesis 7 was accepted. Therefore, Jigsaw and NHT learning techniques of collaborative learning strategy do not differ significantly in enhancing academic achievement of students in mathematics.

Summary of the Findings

From the analysis, the following findings were made:

1. Students' Team Achievement Division Learning Technique is effective on academic achievement of students in mathematics.
2. Jigsaw learning technique is effective on academic achievement of students in mathematics.
3. Number Heads Together learning technique is effective on academic achievement of students in mathematics.

4. Students who studied using STAD performed slightly better than those who used Jigsaw and those who used NHT.
5. Students' Team Achievement Division learning technique is significant in enhancing academic achievement of students in mathematics.
6. Jigsaw learning technique is significant in enhancing academic achievement of students in mathematics.
7. NHT learning technique is significant in enhancing academic achievement of students in mathematics.
8. STAD, Jigsaw and NHT learning techniques do not differ significantly in enhancing academic achievement of students in mathematics.
9. STAD and Jigsaw learning techniques do not differ significantly in enhancing academic achievement of students in mathematics.
10. STAD and NHT learning techniques do not differ significantly in enhancing academic achievement of students in mathematics.
11. Jigsaw and NHT learning techniques do not differ significantly in enhancing academic achievement of students in mathematics.

CHAPTER FIVE

DISCUSSION OF RESULTS, CONCLUSION AND RECOMMENDATIONS

This chapter presents the discussion of results, conclusion and recommendations. It also presents implications of the study, limitations of the study and suggestions for further research.

Discussion of Findings

The discussion is presented according to the findings of major concerns in the study under the following subheadings:

1. Effect of Students Team Achievement Division (STAD) learning technique on students' academic achievement in mathematics.
2. Effect of Jigsaw (JS) learning technique on students' academic achievement in Mathematics.
3. Effect of Number Heads Together (NHT) learning technique on students' academic achievement in mathematics.
4. Effectiveness of the learning techniques (STAD, JS, NHT) compared.

Effect of Student Team Achievement Division (STAD) learning technique on students' academic achievement in mathematics.

Results of the study reveals that the achievement of students who were exposed to STAD learning technique is significantly enhanced more than those in control group that used conventional method of learning. The improved achievement may be attributed to the fact that students in experimental groups may have studied with peer language and were alife to their responsibilities. This indicated that high level of interaction amongst group members is very crucial in

the learning and better achievement of students in mathematics. Hence, STAD could be said to be effective and has every potential to enhancing students' academic achievement in mathematics.

The present finding concords with earlier results of Adesoji and Tundey (2010) Budasi (2012) Ike (2011) which indicated that STAD is a very effective learning technique. It enabled students in experimental group to participate fully in their learning and were able to outperform other students in the control group. Similarly, Hsiu-Chuan (1999), Iqable (2004), Njoroge and Githua (2013), Shafqat (2008), Van (2012) revealed that weaker students improved their performance when grouped with high achieving ones. However, the findings of the present study contradicted those of Amstrong (2008), Gul and Hafiz (2009), Abu and Flowers (1997). The studies established no significant difference between those students treated with STAD and the control group but this study asserted significant difference. Looking at the result of the oral appreciation of the students' compiled, one may conclude that the no difference in the researchers' findings may be as a result of some factors like, limited period of implementation (3 weeks), poor implementation and experimental bias.

Effect of Jigsaw (JS) learning technique on students' academic achievement in mathematics.

The finding emanating from this study indicated too that JS learning technique aspect of collaborative learning strategy is equally effective on students' academic achievement in mathematics when compared with the achievement of those students in control group. Jigsaw ensures equal participation and

accountability. Group members were both students and teachers in their various expert and home groups which contributed to better understanding and enhanced performance. JS therefore is proved significant in enhancing students' academic achievement in mathematics. There is a significant difference in the mean gain score achievement of student who used JS learning technique when compared with those in control group. The finding is in line with the previous studies of Arin (2012), Awoderu (2012), Ghina (2003), Mahnaz (2012), Nugrahwith (2011), Rica (2008) who reported evidence of effectiveness of Jigsaw. They established that the friendliness and assistance that existed among students in experimental group motivated the students' interest to learn more. Furthermore in support of Jigsaw effectiveness, Ali (2010), Luthfillan (2011), Van and Ramon (2011) reported that the group work involved in Jigsaw enabled students to comprehend better and performed better.

Although the earlier mentioned researchers agreed on the effectiveness of Jigsaw, the finding of Maden (2011) was different. It reported no significant difference between the experimental group and the control group. But surprisingly, the Klob inventory given to students by the researcher recorded positive information which shows that some factors must have affected the result adversely.

Effect of Number Heads Together (NHT) Learning Technique on Students' Academic Achievement in Mathematics

The present study further reveals that the academic achievement of students who used NHT learning technique in the studying of mathematics is enhanced. Statistically, the result provides support that NHT learning technique is effective

too on students' academic achievement in mathematics. There is within-Team activities in NHT which affords the members opportunity to face rehearsals in larger class before quiz. This helps the students to evaluate their level of understanding of the topic. The fact that students were aware they could be called upon to answer questions in defence of their group made it imperative for them to pay attention and contribute actively during discussions. The group expectations must have reduced distractions and encouraged concentration.

There is a significant difference between the mean gain score of students who used NHT and those that used conventional method of learning. It actually depicts that NHT is significant in enhancing student's academic achievement in mathematics. The finding corroborates the findings of previous studies and assertions of Maheady et al (1999), Maheady et al (2006) which showed that NHT is more effective in raising student's academic achievement. Also Ratih (2012) reported that students' reading comprehension achievement was significantly increased using NHT.

Effectiveness of the Learning Techniques (STAD, JS, NHT) Compared

When the effectiveness of these learning techniques (STAD, JS, NHT) is compared, the finding indicates that STAD learning technique is most effective in enhancing students' academic achievement when compared with JS and NHT. Students who used STAD had the highest mean gain score followed by JS and NHT (STAD = 26.58, JS = 25.57, NHT = 23.55). The advantage STAD had over JS and NHT may be due to the fact that it has straight forward approach and

structure and simpler to adopt. STAD made use of only small heterogenous groups. The rigour in other learning techniques may not be all that convenient for beginners at initial stage.

The present finding is in line with the studies of Amstrong (1998), Newman and Thompson (1987). They noted that STAD is relatively the easiest and simplest learning technique to be applied by a teacher who has just started using collaborative learning strategy for the first time. Although STAD may be taken to have advantage of its simplicity in the present study, SANTOSH (2012) reported otherwise. Its result showed that JS had a higher mean gain score than STAD which rated JS more effective. All the same the two learning techniques of collaborative learning strategy are equally significant in raising students' achievement as revealed by the present study.

Furthermore, the mean gain score of students exposed to JS is higher than those of NHT which shows that JS is more effective in enhancing academic achievement than NHT. Moreso, from the present finding, the three learning techniques aspects of collaborative learning strategy (STAD, JS, NHT) do not differ significantly in enhancing academic achievement of students in mathematics. The experimental procedures provided opportunities for small group interactions and sharing of resources among team members. The learning environment is student centred, collaborative and none competitive. The finding conforms with that of Arin (2012), Bawn (2007), Gomleksi (2007), Mahnaz (2012), Tzu-Pu (2007) who noted that the learning techniques created condusive learning environment. Supporting the finding still, Hsiu-Chuan (1999) used the

three techniques interchangeably in his study. He applied STAD during introduction of the lesson, followed by JS as a preview and NHT as review learning technique. The result is in consonance with the present finding. Therefore, the three learning techniques of collaborative learning strategy are equally significant in enhancing students academic achievement in mathematics.

Also, the present finding showed that STAD and NHT do not differ significantly in enhancing students' academic achievement in mathematics. The group constitution and reward structure are similar. Bawn (2007), Jeanie (2011) supported the finding indicating that STAD and NHT used the same heterogeneous team and reward structure. Their finding further established that students work harder to earn prize for their group and at the same time improve their academic achievement.

It was gathered too from the finding that STAD and JS do not differ significantly in enhancing students' academic achievement in mathematics. The two learning techniques could be used jointly or separately but they give significant result. The finding tallies with SANTOS (2012) who reported that JS and STAD were significant in improving students' academic achievement and self concept in mathematics.

The present finding revealed also that JS and NHT do not differ significantly in enhancing students' academic achievement in mathematics. The two learning techniques have within-teams. They ensure equal participation and accountability. Hsiu-Chuan (1999) used the two learning techniques and reported improved performance. The present finding is comparable with that of Bilasnami-

Awoderu and Oludipe (2012) who had it that the rate of interaction existing among students accelerated the improved performance.

Conclusion of the Study

Student's poor achievement in mathematics had been a regular occurrence and a great concern to every stakeholder in education. Despite the amount of time, effort and resources spent on alleviating the situation, students still achieve poorly in the subject. This goes a long way to confirm that the question should not only be on "how well taught but also on how well read." Based on this, a more student centered and practical approach to students' learning of mathematics, such as collaborative learning strategy (STAD, JS, NHT) is very much needed to empower students and enhance their academic achievement in mathematics. School guidance counsellors and mathematics teachers therefore should be aware of the skills and techniques required in implementing this strategy by students in the learning of mathematics. They should tailor their group counselling activities and mathematics teaching towards helping students study in groups in order to carry themselves along.

Collaborative learning strategy provides students with the opportunity to get themselves fully engaged with their studies in the learning of mathematics. It instills confidence in them that they can succeed in mathematics. Students actively can construct their knowledge, work collaboratively in groups to achieve common goal. Guidance counsellors should then start early to train students to adopt collaborative learning strategy (STAD, JS, NHT) in their learning of mathematics.

Further studies should apply collaborative learning strategy with more participants, different locations and gender to generate more evidence.

Implication of the Study

The findings of this study prove that collaborative learning strategy can enhance students' academic achievement in mathematics. There has been persistent poor achievement of students in mathematics which was attributed to poor teaching method, lack of teaching facilities among others. The implication of applying collaborative learning strategy (STAD, JS and NHT) by students in the learning of mathematics is that students are capable of solving their mathematical problems themselves. Also that the students have been taught by teachers during class lessons and they now retire in small groups to discuss what they have learnt for better understanding of the material, and suggesting easier ways of tackling the mathematical problems.They can learn above their developmental level,in the words of Vygotsky ,and acquire skills which they can transfer later in solving mathematical problems.

By its nature, collaborative learning strategy is socially and intellectually involving. It places complex tasks, challenges and responsibilities on students, guidance counsellors and teachers. Students in their groups encounter differences, they try had to recognize the differences in order to work with them. They are challenged to spend more time, energy and be committed to helping other group members to succeed.

It was observed that students have been gathering in groups to carry out one project or assignment, but it had not been as organized as the collaborative

learning strategy. It is thus very necessary for guidance counsellor to start early to counsel students on effective application of collaborative learning strategy bearing in mind the five elements of collaborative learning. Effective implementation of collaborative learning strategy by students amounts a lot of pressure on guidance counsellors. They should spend extra time after official hours ,counseling, supervising and assisting students in their group learning.

Recommendations

Based on the findings and implications of the study, the following recommendations are made:

(1) STAD is highly recommended by the researcher for the learning of SS I students' mathematics.

(2) Also, Jigsaw is recommended for the students in the learning of SS I mathematics.

(3) The application of Number Heads Together learning techniques is recommended too for the learning of mathematics.

(4) Based on the findings too, the school guidance counsellor should include collaborative learning strategy (STAD, JS, NHT) in the group counselling programme of students; so as to groom them early enough for effective implementation.

(5) Awareness should be created by the school guidance counsellor for parents during Parent Forum and Parent Teachers' Association (PTA) meeting on the meaning, importance and application of collaborative learning strategy.

It will enable parents to appreciate the strategy and encourage their children and ward to implement it in their studies.

(6) Collaborative learning strategy should be encorporated in the curriculum of teachers and guidance counsellors in training to acquaint them with the skills involved in implementation of the strategy .

Limitation of the Study

The researcher met a lot of limitations on this study. Among them are:

1. Population Sample Size: The study was limited to Awka Metropolis in Awka Education Zone of Anambra State. The sample size was relatively small which would have affected the generalization. But since the study is quasi experimental, it needed to be done on a selected portion of the population.
2. Group Placement Limitation: There was the challenge of students preferring to be grouped with their friends or particular high achieving students. The challenge was arrested through counselling and use of mathematics progressive register.
3. Rejection Attitude: The high achievers' rejection to participate in any group activities was a big challenge. They felt it will be a waste of time teaching others what they know without learning more but the students were encouraged through counselling.

Suggestions for Further Research

Based on the limitations encountered in this study which deterred the making of general observation the following suggestions were made:

1. The size of the study should be increased.
2. The study should be repeated in other Educational Zones of the State.
3. Students in boarding houses and rural areas could be used as sample size and population.
4. Interactive effect of gender during the treatment period should be investigated.
5. Long term effect of the treatment could be studied using some sample, pretest and post test.
6. The study could be carried out using other learning techniques that were not embarked on.

Summary of the Study

The study is a quasi experimental with pretest posttest equivalent group design conducted to determine the effectiveness of collaborative learning strategy in enhancing students' academic achievement in mathematics. The study aims at determining whether Student Team Achievement Division (STAD), Jigsaw (JS) and Number Heads Together (NHT) learning techniques aspects of collaborative learning strategy can enhance the academic achievement of students in mathematics. The study is deeply rooted on behavioural, social interdependence and cognitive theories. The sample size of the study consisted of 173 SS I students

purposefully drawn from four co-educational secondary schools in Awka metropolis of Awka education zone. Four research questions were answered and seven hypothesis tested at 0.05 level of significance. In collecting data for the study, a 35 item pretest, posttest achievement test constructed by four mathematics teachers from the sampled schools, duely validated and reliability determined came to play. The achievement test was administered to the participants before and after the treatment. Data collected was analyzed using mean and standard deviation, and ANCOVA.

From the analysis and discussion of the study the following conclusion were drawn:

1. STAD learning technique is effective on academic achievement of students in mathematics.
2. JS learning technique is effective on students' academic achievement in mathematics.
3. NHT learning technique is m effective on students academic achievement in mathematics.
4. Students who studied using STAD were best when compared with those who used JS and NHT. Therefore STAD is most effective on students' academic achievement in mathematics
5. STAD learning technique is significant in enhancing academic achievement of students in mathematics.
6. JS learning technique is significant in enhancing students academic achievement in mathematics.

7. NHT learning technique is significant in enhancing students' academic achievement in mathematics.
8. STAD, JS and NHT learning techniques do no differ significantly in enhancing students' academic achievement in mathematics.
9. There is no significant difference in the mean scores of students exposed to STAD and Jigsaw learning techniques in enhancing students academic achievement in mathematics.
10. STAD and NHT learning techniques do not differ significantly in enhancing academic achievement of students in mathematics.
11. JS and NHT learning techniques do not differ significantly in enhancing students' academic achievement in mathematics.

Therefore, collaborative learning strategy has every evidence to support the fact that it can effect students' academic achievement in mathematics.

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APPENDIX A

PRETEST ACHIEVEMENT TEST

1. $Y \propto x$ and when y = 3, x = 4. What is the constant of variation?
   (A) 3 (B) $^3/_4$ (C) 4 (D) $^4/_3$
2. $A \propto \sqrt{B}$ and when B = 16, A = 6. What is the constant of variation?
   (A) 3 (B) 1 ½ (C) 2 (D) 6
3. $V \propto H^2$, when V = 144, H = $^3/_2$. What is the constant of variation?
   (A) 64 (B) 3 (C) $^9/_4$ (D) 16
4. If $y \propto x$ and y = 140 when x = 30, find the relationship between y and x
   (A) y = 4x (B) y = $^3/_{14}x$ (C) y = 3 x (D) y = $^{14x}/_3$
5. Using the information given in No 4 above, find the value of x when y = 170
   (A) 36 (B) $37^1/_7$ (C) 36 $^3/_7$ (D) 37
6. The velocity (v) of an object falling from a height varies directly as the time (t) taken to fall. If V = 16 when t = 2 . Find V when t = 5
   (A) 16 (B) 20 (C) 4 (D) 40
7. The amount of naira (₦) varies directly as the amount of pound sterling (£) as given in the table below. The amount of Naira is ₦25 when the amount is pound sterling is ₦10

₦	2.5	7.5	x	17	25	y
£	z	m	5	n	k	15

Use the above information to answer questions 8 to 13
x is equal to
(A) 12.5 (B) 37.5 (C) 6.8 (D) 3

8. y = ?
   (A) 12.5 (B) 37.5 (C) 6.8 (D) 1
9. z is what?
   (A) 37.5 (B) 12.5 (C) 6.8 (D) 1
10. m = ?
    (A) 6.8 (B) 12.5 (C) 3 (D) 1
11. n is equal to what?
    (A) 3 (B) 6.8 (C) 7 (D) 1
12. k equals
    (A) 6.8 (B) 5 (C) 15 (D) 10

Find the constant of variation in numbers 13 and 14

13. $A \propto \frac{1}{C}$ such that when A = 3, C = 12
    (A) 12 (B) 3 (C) 4 (D) 36
14. $y \propto \frac{1}{x^2}$ such that when y = 10, x = 2
    (A) 40 (B) 20 (C) $\frac{10}{4}$ (D) $\frac{5}{3}$
15. If $x \propto \frac{1}{\sqrt{y}}$ such that when x = 4, y = 4. Find x when y = 9
    (A) $^9/_4$ (B) 36 (C) $2\,^2/_3$ (D) 8
16. If $x \propto \frac{1}{y}$ and $y \propto z$, how does x vary with z?

(A) $x \propto \frac{1}{Z}$ (B) $x \propto z$ (C) $x \propto \sqrt{z}$ (D) $x \propto \frac{1}{\sqrt{z}}$

17. If $q \propto \frac{r}{p^2}$ and r = 10 when p = 6 and q = 3.5. Find the law connecting q, r and p

(A) $q = \frac{12.6r}{p^2}$ (B) $q = \frac{12.6p^2}{r}$ (C) $q = \frac{12.6}{p^2r}$ (D) $q = \frac{12.6r^2}{p}$

18. Find q when r = 9 and p = 2.4

(A) 19.4 (B) 19.7 (C) 19.8 (D) 19.5

19. $V \propto d^2H$: v = 720 when H = 9 and d = 3, Find v when H and d increased by 100%

(A) 1926 (C) 1296 (C) 5760 (D) 1962

20. If r = C + KP when r and p are variables. R = 4 when p = 5 and r = 6, when p = 8; find r when p = 4

(A) $5\ ^2/_3$ (B) $3^1/_3$ (C) 6 (D) $6\ ^2/_3$

21. The cost of running a food canteen is partly constant and partly varies as the square of the number of customers. If the total cost is ₦72 when 6 customers turn up and ₦112 when 10 customers turn up, find the total cost when 16 customers turn up to eat at the canteen.

(A) ₦275.2 (B) ₦209.5 (C) ₦220.75 (D) ₦220

The time (t) taken to buy fuel at a petrol station varies directly as the number of vehicles (v) on queue and jointly varies inversely as the number of pumps (p) available at the station. In a station with 5 pumps it took 10 minutes to fuel 20 vehicles use the above information to answer question 22 to 24

22. Find the relationship connecting t, p and v

(A) $t = \frac{2P}{V}$ (B) $t = \frac{V}{5P}$ (c) $t = \frac{5V}{P}$ (D) $t = \frac{5V}{2P}$

23. Find the time it will take to fuel 50 vehicles in the station with 2 pumps

(A) 1hr, 30min (B) 1hr, 2min, 20 sec (C) 2hr, 1 min 30sec
(D) 1hr, 2min, 30sec

24. Find the number of pumps required to fuel 40 vehicles in 20 min

(A) 5pumps (B) 6pumps (C) 10pumps (D) 100pumps

25. The cost of providing accommodation in a hotel is partly constant and partly varies inversely as the number of people. If the cost of providing accommodation for 20 people is ₦400 and the cost for 15 people is ₦330. Find the cost for 40 people

(A) ₦5050 (B) 5500 (C) ₦5000 (D) ₦405

26. The instrument used in measuring a line segment is _____

(A) Compasses (B) Protractor (C) ruler (D) Protractor and divider

27. The following are the conditions necessary for the construction of a triangle except

(I) given all the three side
(II) given all the angles
(III) given any two sides and one angle
(IV) given any two angles and one side

(A) (I) and (II) (B) (II) only (C) IV and III only (D) I only

28. A straight line with divides an angle into two equal parts is called

(A) angle divider (B) transversal (C) Bisector (D) biangle

29. The following angles can be constructed with a ruler and a pair of compasses only except

(A) 35^o (B) 150^o (C) 135^o (D) 75^o

30. A triangle has_____ sides (A) 4 (B) 2 (C) 3 (D) 5

31. Using a ruler and a pair of compasses only draw and bisect a line segment $\overline{AB}$ = 5cm

32. Using a pair of compasses and ruler only construct a square of sides 4cm

33. Construct a triangle ABC such that AB = 6cm, BC = 7cm and AC = 6.3cm

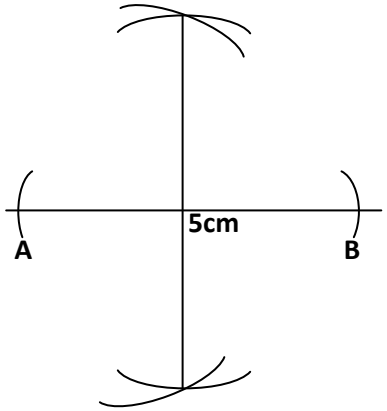
34. Using a ruler and a pair of compasses only construct triangle XYZ such that XY = 6cm, $Y\hat{X}Z = 30^o$ and $X\hat{Y}Z = 60^o$.

35. Using a ruler and a pair of compasses only construct triangle PQR such that $\overline{PQ}$ = 5.3cm, $\overline{PR}$ = 6.2cm and $Q\hat{P}R = 135^o$.

Solution

1.	B	2.	B	3.	A	4.	D	5.	C
6.	D	7.	A	8.	B	9.	D	10.	C
11.	C	12.	D	13.	D	14.	A	15.	C
16.	A	17.	A	18.	B	19.	C	20.	B
21.	B	22.	D	23.	D	24.	A	25.	D
26.	C	27.	B	28.	C	29	A	30	C

(31)



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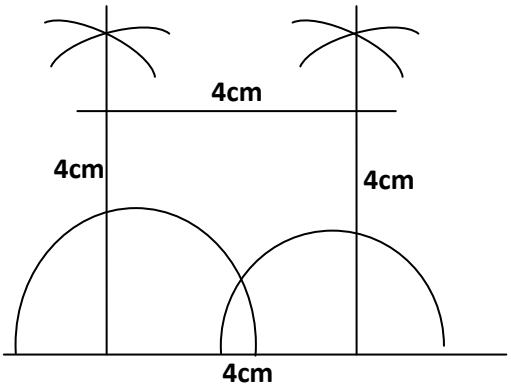

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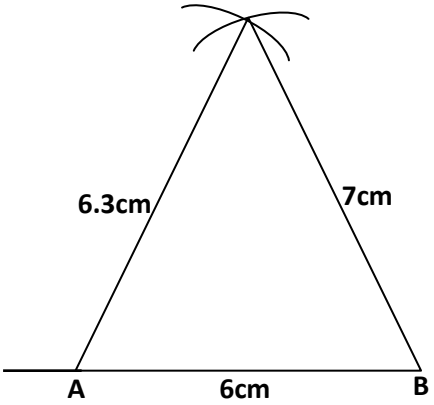

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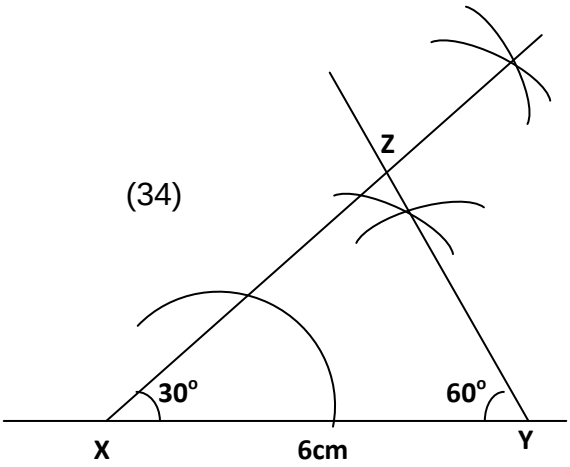

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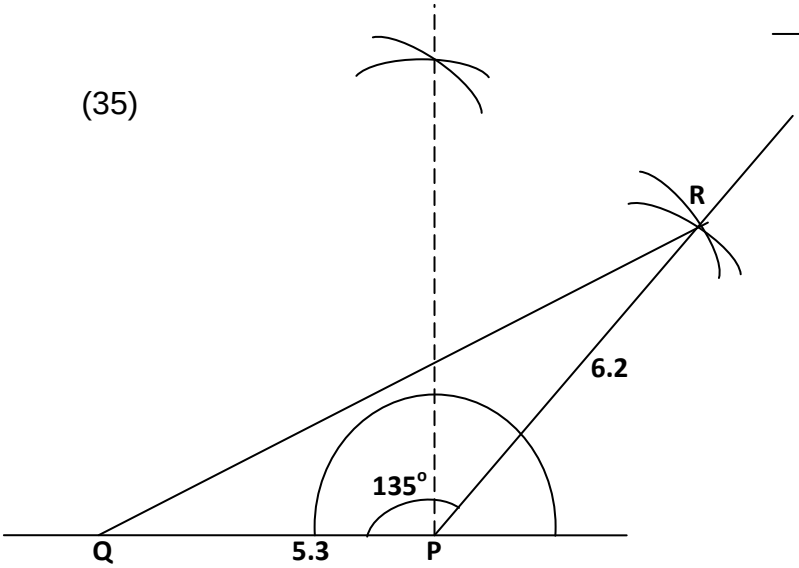


APPENDIX B
POST-TEST ACHIEVEMENT TEST

Find the constant of variation in numbers 1 and 2

1. $A \propto \frac{1}{C}$ such that when A = 3, C = 12
   (A) 12 (B) 3 (C) 4 (D) 36
2. $y \propto \frac{1}{x^2}$ such that when y = 10, x = 2
   (A) 40 (B) 20 (C) $\frac{10}{4}$ (D) $\frac{5}{3}$
3. If $x \propto \frac{1}{\sqrt{y}}$ such that when x = 4, y = 4. Find x when y = 9
   (A) $^9/_4$ (B) 36 (C) $2\,^2/_3$ (D) 8
4. Y ∝ x and when y = 3, x = 4. What is the constant of variation?
   (A) 3 (B) $^3/_4$ (C) 4 (D) $^4/_3$
5. $A \propto \sqrt{B}$ and when B = 16, A = 6. What is the constant of variation?
   (A) 3 (B) 1 ½ (C) 2 (D) 6
6. $V \propto H^2$, when V = 144, H = $^3/_2$. What is the constant of variation?
   (A) 64 (B) 3 (C) $^9/_4$ (D) 16
7. If y ∝ x and y = 140 when x = 30, find the relationship between y and x
   (A) y = 4x (B) $y = {}^3/_{14}x$ (C) y = 3 x (D) $y = {}^{14x}/_3$
8. Using the information given in No 4 above, find the value of x when y = 170
   (A) 36 (B) $37^1/_7$ (C) $36\,^3/_7$ (D) 37
9. If $x \propto \frac{1}{y}$ and y ∝ z, how does x vary with z?
   (A) $x \propto \frac{1}{Z}$ (B) x ∝ z (C) $x \propto \sqrt{z}$ (D) $x \propto \frac{1}{\sqrt{z}}$
10. If $q \propto \frac{r}{p^2}$ and r = 10 when p = 6 and q = 3.5. Find the law connecting q, r and p
    (A) $q = \frac{12.6r}{p^2}$ (B) $q = \frac{12.6p^2}{r}$ (C) $q = \frac{12.6}{p^2r}$ (D) $q = \frac{12.6r^2}{p}$

Using No. 10 question,

11. Find q when r = 9 and p = 2.4
    (A) 19.4 (B) 19.7 (C) 19.8 (D) 19.5
12. $V \propto d^2H$: v = 720 when H = 9 and d = 3, Find v when H and d increased by 100%
    (A) 1926 (C) 1296 (C) 5760 (D) 1962
13. If r = C + KP when r and p are variables. R = 4 when p = 5 and r = 6, when p = 8; find r when p = 4
    (A) $5\,^2/_3$ (B) $3^1/_3$ (C) 6 (D) $6\,^2/_3$
14. The instrument used in measuring a line segment is _____
    (A) Compasses (B) Protractor (C) ruler (D) Protractor and divider
15. The following are the conditions necessary for the construction of a triangle except
    (V) given all the three side
    (VI) given all the angles
    (VII) given any two sides and one angle
    (VIII) given any two angles and one side

(A) (I) and (II) (B) (II) only (C) IV and III only (D) I only

16. A straight line which divides an angle into two equal parts is called
(A) angle divider (B) transversal (C) Bisector (D) biangle
17. The following angles can be constructed with a ruler and a pair of compasses only except
(A) 35^o (B) 150^o (C) 135^o (D) 75^o
18. A triangle has_____ sides (A) 4 (B) 2 (C) 3 (D) 5
19. Using a ruler and a pair of compasses only draw and bisect a line segment $\overline{AB}$ = 5cm
20. Using a pair of compasses and ruler only construct a square of sides 4cm
21. Construct a triangle ABC such that AB = 6cm, BC = 7cm and AC = 6.3cm
22. Using a ruler and a pair of compasses only construct triangle XYZ such that XY = 6cm, $Y\hat{X}Z = 30^o$ and $X\hat{Y}Z = 60^o$.
23. Using a ruler and a pair of compasses only construct triangle PQR such that $\overline{PQ}$ = 5.3cm, $\overline{PR}$ = 6.2cm and $Q\hat{P}R = 135^o$.
24. The velocity (v) of an object falling from a height varies directly as the time (t) taken to fall. If V = 16 when t = 2 . Find V when t = 5
(A) 16 (B) 20 (C) 4 (D) 40
25. The amount of naira (₦) varies directly as the amount of pound sterling (£) as given in the table below. The amount of Naira is ₦25 when the amount in pound sterling is ₦10

₦	2.5	7.5	x	17	25	y
£	z	m	5	n	k	15

Use the above information to answer questions 8 to 13
x is equal to
(A) 12.5 (B) 37.5 (C) 6.8 (D) 3

26. y = ?
(A) 12.5 (B) 37.5 (C) 6.8 (D) 1
27. z is what?
(A) 37.5 (B) 12.5 (C) 6.8 (D) 1

28. m = ?
(A) 6.8 (B) 12.5 (C) 3 (D) 1
29. n is equal to what?
(A) 3 (B) 6.8 (C) 7 (D) 1
30. k equals
(A) 6.8 (B) 5 (C) 15 (D) 10
31. The cost of running a food canteen is partly constant and partly varies as the square of the number of customers. If the total cost is ₦72 when 6 customers turn up and ₦112 when 10 customers turn up, find the total cost when 16 customers turn up to eat at the canteen.
(A) ₦275.2 (B) ₦209.5 (C) ₦220.75 (D) ₦220

The time (t) taken to buy fuel at a petrol station varies directly as the number of vehicles (v) on queue and jointly varies inversely as the number of pumps (p) available at the station. In a station with 5 pumps it took 10 minutes to fuel 20 vehicles use the above information to answer question 22 to 24

32. Find the relationship connecting t, p and v
(A) $t = \frac{2P}{V}$ (B) $t = \frac{V}{5P}$ (c) $t = \frac{5V}{P}$ (D) $t = \frac{5V}{2P}$

33. Find the time it will take to fuel 50 vehicles in the station with 2 pumps
(A) 1hr, 30min (B) 1hr, 2min, 20 sec (C) 2hr, 1 min 30sec
(D) 1hr, 2min, 30sec

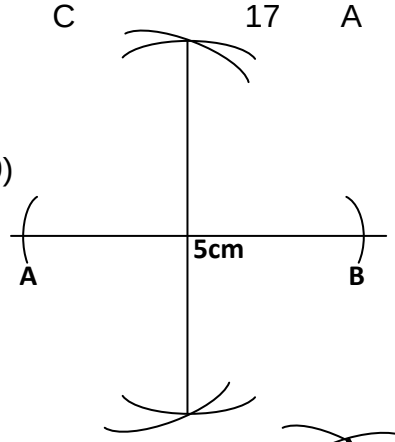
34. Find the number of pumps required to fuel 40 vehicles in 20 min
(A) 5pumps (B) 6pumps (C) 10pumps (D) 100pumps

35. The cost of providing accommodation in a hotel is partly constant and partly varies inversely as the number of people. If the cost of providing accommodation for 20 people is ₦400 and the cost for 15 people is ₦330. Find the cost for 40 people
(A) ₦5050 (B) 5500 (C) ₦5000 (D) ₦405

Solution

1.	D	2.	A	3.	C	4.	B	5.	B
6.	A	7.	D	8.	C	9.	A	10.	A
11.	B	12.	C	13.	B	14.	C	15.	B
16.	C	17	A	18	C				

(19)



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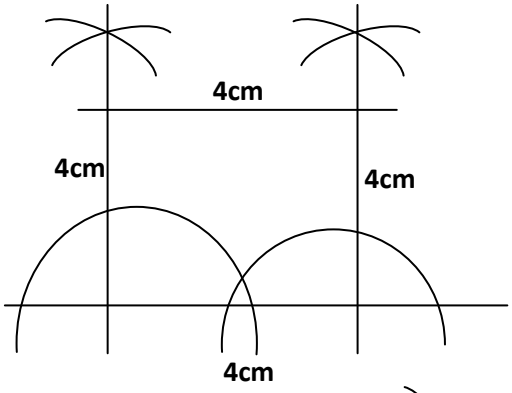

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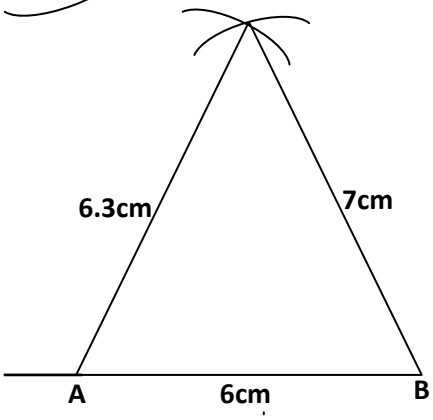

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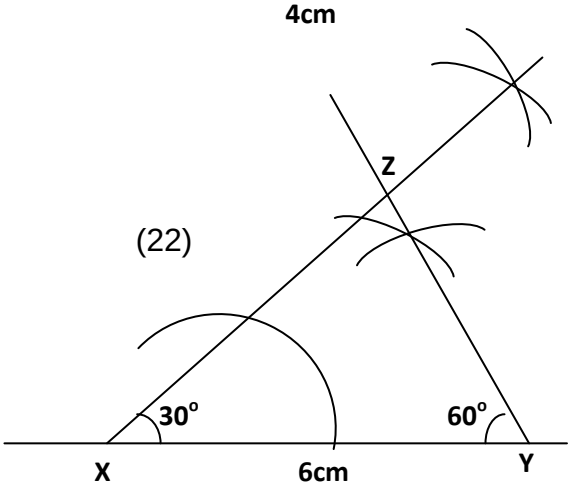

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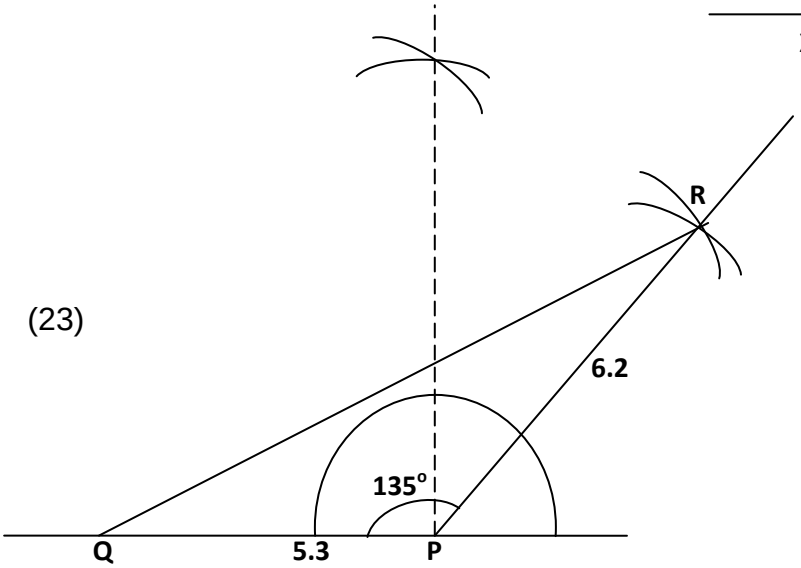


24.	D	25.	A	26.	B	27.	D
28.	C	29.	C	30.	D	31.	B
32.	D	33.	D	34.	A	35.	D

MATHEMATICS SCHEME OF WORK
SS I

Wk	1st TERM
1	Reviewing of last term's work, resumption test and coping of scheme of work for the term for the students
2.	Number base system:- (i) Conversion from one base to base 10.
	(ii) Conversion of decimal fraction in one base to base 10.
	(iii) Conversion of number of one base to another base.
3.	Number Base System: (i) Addition, subtraction, multiplication and division of number bases.
	(ii) Application to computer programming.
4.	MODULAR ARITHMETIC: (i) Revision of addition, subtraction, multiplication and division integers
	(ii) Concept of modular arithmetic.
5.	MODULAR ARITHMETIC: (i) Addition, Subtraction, division and multiplication operations in modular arithmetics (ii) Application of daily life.
6.	INDICES: (i) Revision of standard form,
	(ii) Introduction of indices with example
	3 Laws of indices (a) $a^x \times a^y = a^{x+y}$ (b) $a^x \div a^y = a^{x-y}$
	(c) $(a^x)^y = a^{x \times y}$
	4 Application of indices to simple indicial equation
7.	Mid-term test and Break.
8	LOGARITHM OF NUMBER: (i) Reducing logarithm from indices and standard form.
	(ii) Definition of logarithm.

	Week
9) LOGARITHM: (1) Concept of Characteristics and mantissa (2) Reading of logarithm and antilogarithm table. (3) Use of log and antilog table in calculation in division powers and roots. (4) Calculation involving multiplication.	9
10) SETS: Definition of set (2) Set notation: listing or Roster method, rule method, set builder notation. (3) Types of set: Empty set, guide and infinite sets, Universal sets etc. (4) Set operation (5) Union, Intersection, Complement.	10
Revision, Examination and Marking.	11-14

SCHEME OF WORK
SST
2nd TERM

Week

1. Revision of last term's work, resumption tests and copying of the scheme of work for the students.

2. Simple equation and Variation (1) Change of subject of formular: formular involving brackets, roots and Substitution.

3. VARIATION: (1) Types of variations Direct, inverse, joint and partial (2) Application of variation

4. (1) Revision of factorization of quadratic equation (2) Solution of quadratic equation of the forms $ab = 0$, $a = 0$ or $b = 0$

5. Quadratic Equation

6. (1) Drawing quadratic graph. (2) Obtain roots from quadratic graph (3) Application of quadratic equation to real life situation.

6. LOGICAL REASONING: (1) Simple statements (2) Meaning of simple statements true or false negative of simple statements (3) Compound statements, meaning of conjuction, disjunction, implication, bi-implications.

7. MID TERM TEST | BREAK

8. LOGICAL REASONING: Logical operators and symbols (2) List of logical operators and symbols - True value of :, - A Compound statement,

	Week
negative (NOT), conjuction, — Disjunction — Conditional conditional statements.	
9) CONSTRUCTION: Revision of construction of triangles with given sides (2) Bisection of an angle, 30°, 45°, 60° and 90°.	9
10) CONSTRUCTION, Continue	10
11) Revision	11
12) Exams/Result Processing.	12

SCHEME OF WORK

SSI

3rd TERM

1. Revision of the last terms work/Resumption test.

2. PROOF OF SOME BASIC THEOREM. (i) Angle sum of a triangle is 180° (ii) The exterior angle of a triangle is equal to the sum of two interior opposite angles.
Riders: (i) Angles of a parallel line.
(ii) Angles in Polygon
(iii) Congruent triangles
(iv) Properties of parallelogram and intercept theorem.

3. TRIGONOMETRIC RATIOS: Trig. ratios of 30°, 45°, 60° and 90°

4. Application of trig. ratios to simple problems.
(2) Trig. ratios related to the unit circle.
(3) Graph of sine and cosine.

5. MENSURATION: length of arcs of circle
(2) Perimeter of sector and segment.
(3) Area of sectors of a circle and segment
(4) Relationship between the sector of a circle and the surface area of a cone.

6. MENSURATION OF SOLID SHAPES: (1) Surface area and volume of solids (2) Cube and cuboids (iii) Cylinder, Cone, prism and pyramids.

7. MID TERM TEST/BREAK

	Week
negative (NA), conjuction, – Disjunctions — ~~Conditional~~ Conditional statements.	
9) CONSTRUCTION: Revision of Construction of triangles with given sides (2) Bisection of an angle, 30°, 45°, 60° and 90°.	9
10) CONSTRUCTION, Continue	10
11) Revision	11
12) Exams/Result Processing.	12

Appendix C: Summary of 2009 JSSCE Result in Mathematics

ZONE: AWKA
L.G.A. AWKA SOUTH
SCHOOL: C.S.S. OKPUNO

NO.	SUBJECTS	NO. OF CANDIDATE	TOTAL A'S	% A'S	TOTAL C'S	% C'S	TOTAL P'S	% P'S	F'S	TOTAL C AND ABOVE	TOTAL P AND ABOVE	% C AND ABOVE	% P AND ABOVE ie % PASS	% FAIL	REMARKS
1.	ENGLISH LANG.	115	1	0.9	47	40.9	67	58.3	0	48	115	41.7	100	NIL	2 Absent
2.	MATHEMATICS	115	NIL	NIL	11	9.6	103	89.6	1	11	114	9.6	99.1	0.9	2 Absent
3.	INT. SCIENCE	115	1	0.9	41	35.7	72	62.5	1	41	114	35.7	99.1	0.9	2 Absent
4.	SOCIAL STUDIES	115	1	0.9	31	27	82	71.3	1	32	114	27.8	99.1	0.9	2 Absent
5.	IGBO	115	NIL	NIL	40	34.8	75	65.2	NIL	40	115	34.8	100	NIL	2 Absent
6.	BUS. STUDIES	115	NIL	NIL	31	27	79	68.7	5	31	110	27	95.7	4.3	2 Absent
7.	AGRIC SCIENCE	115	1	0.9	27	23.5	83	72.2	4	28	111	24.3	96.5	3.5	2 Absent
8.	HOME ECONOMICS	115	2	1.7	35	30.4	78	67.8	NIL	37	115	32.2	100	NIL	2 Absent
9.	C&R.K	115	NIL	NIL	28	24.3	84	73.0	3	28	112	24.3	97.4	2.6	2 Absent
10.	H.P.E	115	NIL	NIL	36	31.3	79	68.7	NIL	36	115	31.3	100	NIL	2 Absent
11.	FINE ART	78	2	2.6	39	50	35	44.9	2	41	76	52.6	97.4	2.6	2 Absent
	MUSIC	55	NIL	NIL	19	34.5	16	45.7	NIL	19	35	54.3	100	NIL	2 Absent
															~~2 Absent~~

21/8/09

Eneka, I.V.E (Mrs)
Principal

APPENDIX B2

195

ANALYSIS OF J S C E RESULTS

YEAR :- 2009.

NE :- AWKA

G.A: AWKA SOUTH.

OOL : C.S.S. AGULU-AWKA

SUBJECT	NO OF CANDIDATES	NO OF A'S (1–3)	C'S (4–6)	PS (7–8)	F'S 9	TOTAL C & ABOVE	% C & ABOVE	TOTAL P & ABOVE	% P & ABOVE	% FAIL	NAME OF TEACHER.
ENGLISH	78	1	19	57	1	20	25.6	77	98.7	1.3	NWOSU C N & ANIEBOBA E
MATHEMATICS	78	—	6	72	—	6	7.7	78	100	0	EZEUDU E.C & OKAFOR G
INT. SCIENCE	78	—	15	62	1	15	19.2	77	98.7	1.3	MACHIE A. N.
INTRO TECH.	78	2	22	53	1	24	30.8	77	98.7	1.3	CHIBOR F N & EKEKE I E
SOCIAL STUDIES	78	—	24	52	2	24	30.8	76	97.4	2.6	AGUSIOBU C C & EZEUKO P
IGBO	78	3	25	59	1	28	35.9	77	98.7	1.3	UFOMADU M. U.
BUSINESS STUDIES	78	2	29	47	—	31	39.7	78	100	0	CHUKWUKANMA G.
AGRIC SCIENCE	78	3	22	53	—	25	32.1	78	100	0	ODINAMKPA N. R.
HOME ECONS.	78	1	18	58	1	19	24.4	77	98.7	1.3	ILEGBUNE G / OKAFOR G & NWAMKWO B
RELIGIOUS KNOWL	78	—	13	63	2	13	16.7	76	97.4	2.6	OBAMALU R A & NDUKWU H
[illegible] /ED	78	—	29	47	2	29	37.2	76	97.4	2.6	OFODILE T. N.
ART	78	1	27	49	1	28	35.4	77	98.7	1.3	OBOEKECHUKWU E.
MUSIC	75	3	38	34	—	41	[illegible]	75	100	0	EKEMEZIE B. O.

COMMUNITY SECONDARY S...

EZIAWKA COMMUNITY SECONDARY SCHOOL AWKA

SUMMARY OF 2009 JSSCE RESULT

	No RES	NO OF AS	% A	NO OF Cs	% C	No of Ps	% P	No OF Fs	% F	NAME OF TEACHER
	112	—	—	27	24.1	82	73.2	3	2.6	OKEKE N.C
Y	112	—	—	07	62.6	102	91.1	03	2.6	ADI, J.I
	112	—	—	24	21.4	85	75.9	03	2.6	NWOLISE J.O / OBENAZOEZE R.I
	112	—	—	26	23.2	82	73.2	04	3.6	MENIRU D.S
TECH	112	—	—	17	15.2	95	84.8	—	—	NWANKWO M.O
STUDIES	112	—	—	35	31.3	76	67.9	01	0.9	OKPOKO E.N & EGWUONWU E
	112		—	25	22.3	84	0.75	03	2.6	OJIMBA M.A
UDIES	112	—	—	26	23.2	86	76.8	—	—	ISWEZIGIA F.C
SC	112	—	—	34	30.3	77	68.8	01	0.9	NWABUEZE M.C
	112	—	—	42	37.5	69	61.6	01	0.9	AKUJE F.E / AMUMEKEZE T
NOWC	112	—	—	29	25.9	81	72.3	02	1.7	OKEKE F.O
	34	—	—	12	35.3	22	64.7	—	—	NWAFOR M.N

OKEKE, E.C (MRS)
PRINCIPAL
19-12-09

ANALYSIS OF JSCE RESULT

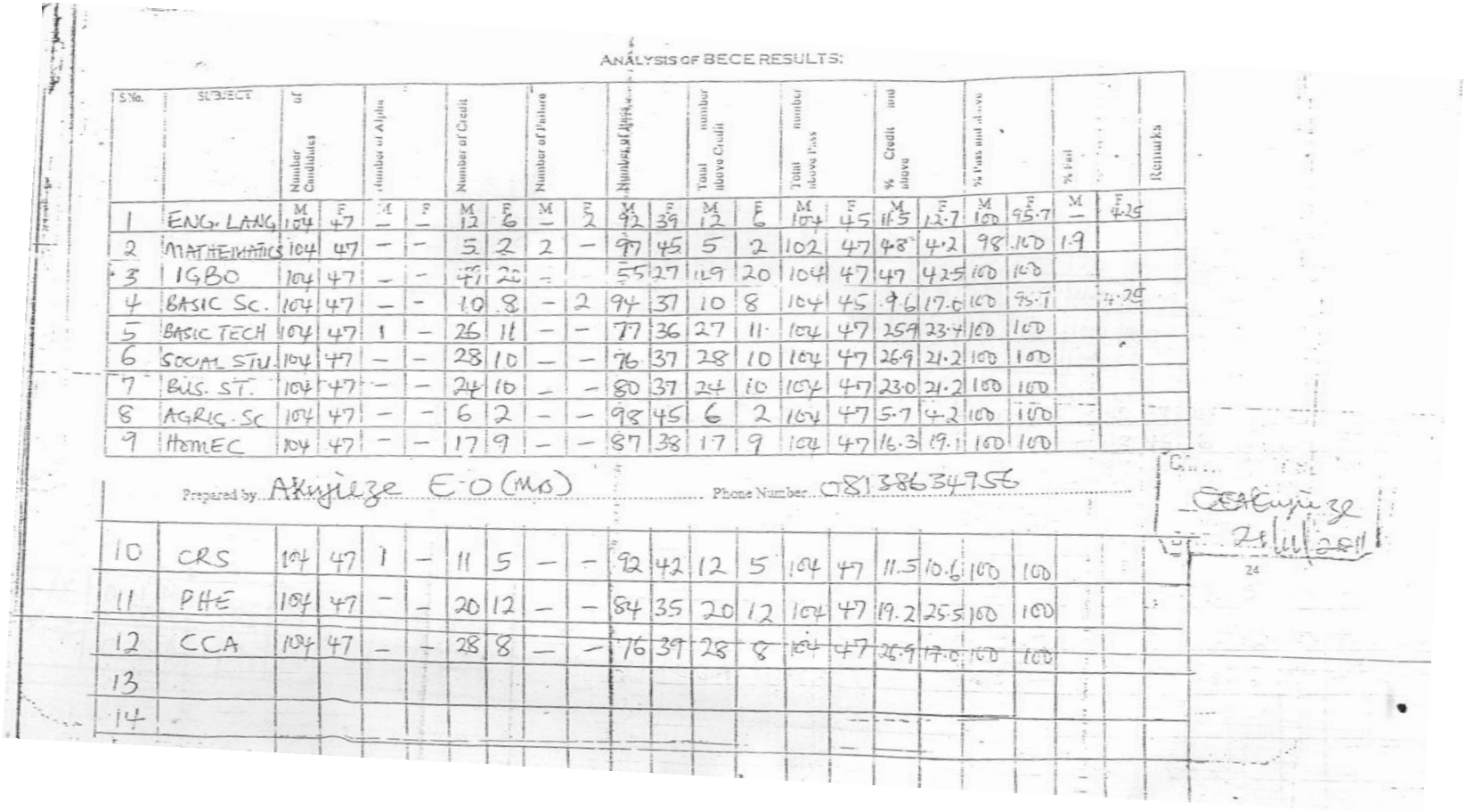
YEAR : 2009

CAPITAL CITY SEC. SCH. AWKA PRINCIPAL DATE: 26-10-09

AWKA
AWKA SOUTH
CAPITAL CITY SECONDARY SHOOL, AWKA

:CT	NO OF CANDIDATES	NO OF As	% OF As	NO OF Cs	C+A	% OF C+A	NO OF Ps	% OF Ps	NO OF Fs	% OF Fs	REMARK
LANGUAGE	160	4	3	53	57	36	100	63	3	2	
:ATICS	157	—	—	23	23	15	135	85	1	1	
CIENCE	158	—	—	46	46	29	100	70	2	1	
TECHNOLOGY	159	4	3	67	71	45	83	52	5	3	
STUDIES	159	—	—	36	36	23	121	76	2	1	
	159	1	1	58	59	37	88	55	12	8	
; STUDIES	159	1	1	48	49	31	105	66	5	3	
SCIENCE	159	—	—	35	35	22	120	75	4	3	
ECONS	159	2	1	52	54	34	101	64	4	3	
S	159	—	—	54	54	34	103	65	2	1	
	158	2	1	47	49	31	102	65	7	4	
ART	87	3	3	37	40	46	44	51	3	3	
	56	—	—	20	20	36	36	64	—	—	

Appendix D: Summary of 2010 JSSCE Result in Mathematics



ANALYSIS OF BECE RESULTS:

S/No.	SUBJECT	Number of Candidates		Number of Alpha		Number of Credit		Number of Failure		Number of Sitting		Total number above Credit		Total number above Pass		% Credit and above		% Pass and above		% Fail		Remarks
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
1	ENG. LANG	104	47	—	—	12	6	—	2	92	39	12	6	104	45	11.5	12.7	100	95.7	—	4.25	
2	MATHEMATICS	104	47	—	—	5	2	2	—	97	45	5	2	102	47	4.8	4.2	98	100	1.9		
3	IGBO	104	47	—	—	41	20	—		55	27	29	20	104	47	47	42.5	100	100			
4	BASIC Sc.	104	47	—	—	10	8	—	2	94	37	10	8	104	45	9.6	17.0	100	95.7		4.25	
5	BASIC TECH	104	47	1	—	26	11	—	—	77	36	27	11	104	47	25.9	23.4	100	100			
6	SOCIAL STU	104	47	—	—	28	10	—	—	76	37	28	10	104	47	26.9	21.2	100	100			
7	BUS. ST.	104	47	—	—	24	10	—	—	80	37	24	10	104	47	23.0	21.2	100	100			
8	AGRIC. Sc	104	47	—	—	6	2	—	—	98	45	6	2	104	47	5.7	4.2	100	100			
9	HOMEC	104	47	—	—	17	9	—	—	87	38	17	9	104	47	16.3	19.1	100	100			

Prepared by Akujieze E.O (MD) Phone Number 08138634756

Akujieze 24/11/2011

10	CRS	104	47	1	—	11	5	—	—	92	42	12	5	104	47	11.5	10.6	100	100			
11	PHE	104	47	—	—	20	12	—	—	84	35	20	12	104	47	19.2	25.5	100	100			
12	CCA	104	47	—	—	28	8	—	—	76	39	28	8	104	47	26.9	17.0	100	100			
13																						
14																						

NAME OF SCHOOL: COMMUNITY SECONDARY SCHOOL OKPUNO
L.G.A AWKA SOUTH ZONE: AWKA

JSCE ANALYSIS 2010

S/N	SUBJECT	NO OF CAND	NO OF A'S	% A	NO OF C'S	% C	NO OF A&C	% A&C	NO OF P'S	% P	NO OF PAND ABOVE	% PAND ABOVE	NO OF F	%OF F	REMARKS
1	ENGLISH	96	NIL	NIL	37	38.5	37	38.5	57	59.4	94	97.9	2	2.1	
2	MATHEMATICS	96	NIL	NIL	8	8.3	8	8.3	83	86.5	91	94.8	5	5.2	
3	INT. SCIENCE	96	NIL	NIL	17	17.7	17	17.7	79	82.3	96	100	NIL	NIL	
4	SOC. STUDY	95	NIL	NIL	29	30.5	29	30.5	64	67.4	93	97.9	2	2.1	
5	IGBO	96	1	1.0	30	31.3	31	32.3	64	66.7	95	99	1	1.0	
6	BUS. STUDY	95	NIL	NIL	30	31.6	30	31.6	59	62.1	89	93.7	6	6.3	
7	AGRIC SCIENCE	96	1	1.01	22	22.9	23	24	72	75	95	99	1	1.0	
8	HOMEC	96	NIL	NIL	30	31.3	30	31.3	63	65.6	93	96.9	3	3.1	
9	CRK	96	NIL	NIL	17	17.7	17	17.7	74	77.1	91	94.8	5	5.2	
10	HPE	95	3	3.2	28	29.5	31	32.6	62	65.3	93	97.9	3	3.2	
11	FINE ART	69	NIL	NIL	8	11.6	8	11.6	56	81.2	64	92.8	5	7.2	
12	MUSIC	29	1	3.4	15	51.7	16	55.2	12	41.4	28	96.6	1	3.4	

COMMUNITY SECONDARY SCHOOL OKPUNO
PRINCIPAL
DATE: 5/11/10
OKPUNO

Eneka, I VE (MRS)
Principal

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EZI-AWKA C.S.S. AWKA ALGA AWKA SOUTH, Zone: AWKA ..... Term, 2016/2017 Academic Session.

Appendix: 17.

ANALYSIS OF BECE RESULTS:

S/No.	SUBJECT	Number of Candidates M	Number of Candidates F	Number of Alpha M	Number of Alpha F	Number of Credit M	Number of Credit F	Number of Failure M	Number of Failure F	Number of Pass M	Number of Pass F	Total number above Credit M	Total number above Credit F	Total number above Pass M	Total number above Pass F	% Credit and above M	% Credit and above F	% Pass and above M	% Pass and above F	% Fail M	% Fail F	Remarks
1	ENG. LANG	58	70			7	11	—	1	45	66	—	—	7	11	5.4	8.6	40.6	59		0.8	
2	MATHS	58	70	—	—	2	6	—	1	52	67	—	—	2	6	1.5	4.6	42.1	57.8		0.8	
3	IGBO LANG	58	70	—	—	16	24	—	—	38	50	—	—	16	24	12.5	18.7	42.1	57.8			
4	BASIC SC.	58	70	—	—	7	11	—	—	50	60	—	—	7	11	5.4	8.6	40.5	55.4			
5	BASIC TECH	58	70	—	—	4	6	—	—	51	67	—	—	4	6	3.1	4.7	43	57			
6	SOC. STUD	58	70	—	—	10	15	—	1	50	53	—	—	10	15	7.8	11.7	46.8	53.1		0.8	
7	BUS. EDN	58	70	—	—	6	13	—	—	53	56	—	—	6	13	4.7	10	46	53.9			
8	AGRI. SC.	58	70	—	—	4	7	—	—	48	69	—	—	4	7	3.1	5.4	40.6	59			
9	HOMEC	58	70	—	—	14	20	—	—	40	54	—	—	14	20	10.9	15.6	42.1	57.8			
10	C.R.S.	58	70	—	—	4	8	—	—	50	66	—	—	4	8	3.1	6.2	42.1	57.8			
11	P.H.E	58	70	—	—	10	14	—	—	46	58	—	—	10	14	7.8	10.9	43.7	56.2			
12	C.C.A	58	70	—	—	6	10	—	—	48	64	—	—	6	10	4.6	7.8	42.1	57.8			

Prepared by..... Phone Number.....

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NAME OF SCHOOL: COMMUNITY SECONDARY SCHOOL OKPUNO
L.G.A AWKA SOUTH ZONE: AWKA

JSCE ANALYSIS 2010

S/N	SUBJECT	NO OF CAND	NO OF A'S	% A	NO OF C'S	% C	NO OF A&C	% A&C	NO OF P'S	% P	NO OF PAND ABOVE	% PAND ABOVE	NO OF F	%OF F	REMARKS
1	ENGLISH	96	NIL	NIL	37	38.5	37	38.5	57	59.4	94	97.9	2	2.1	
2	MATHEMATICS	96	NIL	NIL	8	8.3	8	8.3	83	86.5	91	94.8	5	5.2	
3	INT. SCIENCE	96	NIL	NIL	17	17.7	17	17.7	79	82.3	96	100	NIL	NIL	
4	SOC. STUDY	95	NIL	NIL	29	30.5	29	30.5	64	67.4	93	97.9	2	2.1	
5	IGBO	96	1	1.0	30	31.3	31	32.3	64	66.7	95	99	1	1.0	
6	BUS. STUDY	95	NIL	NIL	30	31.6	30	31.6	59	62.1	89	93.7	6	6.3	
7	AGRIC SCIENCE	96	1	1.0	22	22.9	23	24	72	75	95	99	1	1.0	
8	HOMEC	96	NIL	NIL	30	31.3	30	31.3	63	65.6	93	96.9	3	3.1	
9	CRK	96	NIL	NIL	17	17.7	17	17.7	74	77.1	91	94.8	5	5.2	
10	HPE	95	3	3.2	28	29.5	31	32.6	62	65.3	93	97.9	3	3.2	
11	FINE ART	69	NIL	NIL	8	11.6	8	11.6	56	81.2	64	92.8	5	7.2	
12	MUSIC	29	1	3.4	15	51.7	16	55.2	12	41.4	28	96.6	1	3.4	

COMMUNITY SECONDARY SCHOOL OKPUNO
PRINCIPAL
DATE 5/11/10

VE (Mrs) Emek
Principal

ANALYSIS OF J.S.C.E

YEAR : 2010

E: AWKA

A: AWKA SOUTH

HOOL & COMMUNITY SECONDARY SCHOOL AGULU-AWKA

SUBJECT	NO OF CAND REG.	NO OF CAND ABS	NO OF A's		NO OF C's		NO OF P's		NO OF F's		NO OF C's & ABOVE		NO OF P's & ABOVE		NO OF F's		NAME OF TEACHER
			NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	
...ISH LANGUAGE	60	2	—	—	19	39.8	39	67.2	—	—	19	39.8	58	100	—	—	NWOSU C.N; ANIZOBA E.O AGBA S.I
...THEMATICS	60	3	—	—	2	3.5	54	94.7	1	1.7	2	3.5	56	98.2	1	1.8	EZ[illegible] E.O & OKAFOR G.I
...SIC SCIENCE	60	2	—	—	22	37.9	36	62.1	—	—	22	37.9	58	100	—	—	NNACHIE A.N & OKEKE I.E
...SIC TECHNOLOGY	60	2	—	—	23	39.7	34	58.6	1	1.7	23	39.7	57	98.3	1	1.7	CHIBOR P.N.
...IAL STUDIES	60	2	—	—	18	31	40	69	—	—	18	31	58	100	—	—	EZEUKO P.N & AGUSIOBU C.C
...SINESS STUDIES	60	2	—	—	20	34.5	37	63.8	1	1.7	20	34.5	57	98.3	1	1.7	CHUKWUKANNA N.G.
...BO LANGUAGE	60	2			13	22.4	43	74.1	2	3.4	13	22.4	56	96.6	1	3.4	UFOMADU N.U & OLI L.A.
...RICULTURE	60	2	—	—	15	25.9	42	72.4	1	1.7	15	25.9	57	98.3	1	1.7	ODINAMKPA N.R
...E ECONOMICS	60	2	—	—	25	43.1	31	53.5	2	3.4	25	43.1	56	96.6	2	3.4	NNANKWO D.N, OKAFOR [illegible]
R.S	60	2	—	—	22	37.9	35	60.5	1	1.7	22	37.9	57	98.3	1	1.7	[illegible]OLEKWU H.N, ORAKWU R.I
...I & HEALTH EDU.	60	2	—	—	16	27.6	40	69	2	3.4	16	27.6	56	96.6	2	3.4	AGUDOSI A.N & OFODILE T.[illegible]
...E ART	60	2	—	—	25	43.1	32	55.2	1	1.7	25	43.1	57	98.3	1	[illegible]	EDOGECHINA E

COMMUNITY SECONDARY SCHOOL
PRINCIPAL
DATE 2/4/10
AGULU-AWKA

JSCE RESULT ANALYSIS 2009/2010

EZI-AWKA COMMUNITY SECONDARY SCHOOL AWKA

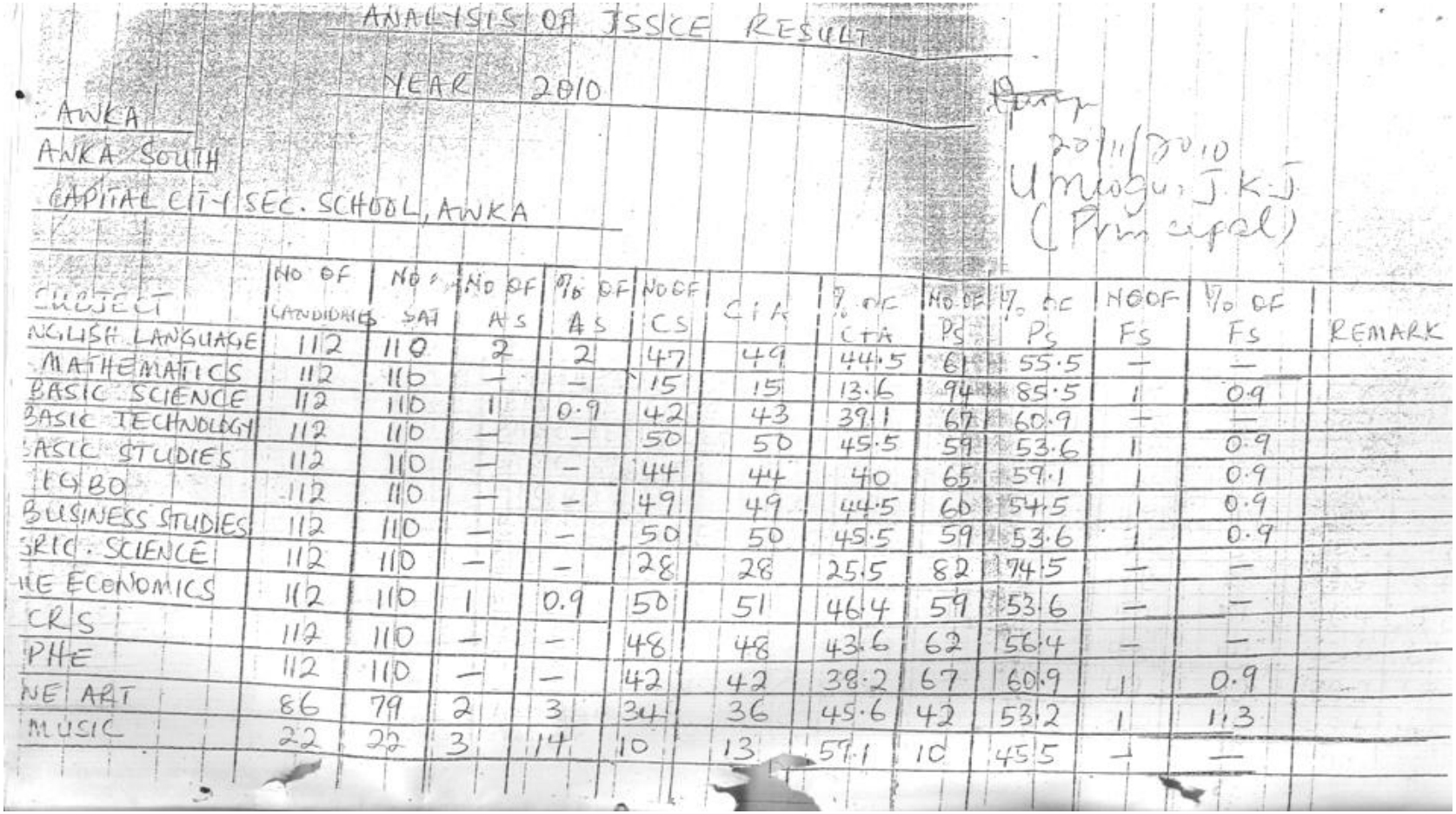
S/N	SUBJECTS	NO REGISTERED	NO SAT	GRADE NO OF A	NO OF C	QUALITY PASS A-C	% P	Grade NO OF P	% P	Grade NO OF F	% F	Name of Teacher	Remark
1	ENGLISH	112	112	–	27	27	24	82	72	3	2.7	ANACHO, B.N	
2	IGBO	112	112	–	26	26	23	85	75.8	1	0.8	EGWUATU, I.E. OKPOKO, E.H	
3	MATHEMATICS	112	112	–	7	7	6.3	102	91	3	2.7		
4	INTEGRATED SCIENCE	112	112	–	25	25	22	84	75	3	2.7	NWOLISE J	
5	INTRODUCTORY TECHNOLOGY	112	112	–	25	25	22	83	74	4	3.6	NKWORKA, W.C.	
6	SOCIAL-STUDIES	112	112	–	18	18	16	94	84	–	–	JAMES, M.O. IMAGIE, A.D.F.	
7	FRENCH	–	–	–	–	–	–	–	–	–	–		
8	BUS. STUDIES	112	112	–	25	25	22	84	75	3	2.7	[illegible]	
9	AGRICULTURE SCIENCE	112	112	–	26	26	23	84	75	–	–	IGWEBIBIA F.C.	
10	PHYSICAL & HEALTH EDU.	112	112	–	29	29	26	83	74	2	1.8	OKEYE, F.C.	
11	MUSIC	34	34	–	12	12	35	22	64	–	–	NWOKEDI, O.C.	
12	LOCAL CRAFT / ART	–	–	–	–	–	–	–	–	–	–		
13	HOME. ECONOMICS	112	112	–	34	34	30	77	69	1	0.8	NWABUEZE, M.C. NWOBIA, A.N. NWANKWO, E.H.	
14	C.R.K.	112	112	–	33	33	29	78	70	1	0.8	AKUDE, B.F. AMAMARAELE, J.N.	
15	COMPUTER EDUCATION	–	–	–	–	–	–	–	–	–	–		

AVERAGE % PASS = $\frac{1179}{12}$ = 98%

AVERAGE % Failure = $\frac{18.6}{12}$ = 1.6%

[signature] 8/11/10

OKEKE, E.C (MRS)



ANALYSIS OF JSSCE RESULT

YEAR 2010

ANKA

ANKA SOUTH

CAPITAL CITY SEC. SCHOOL, ANKA

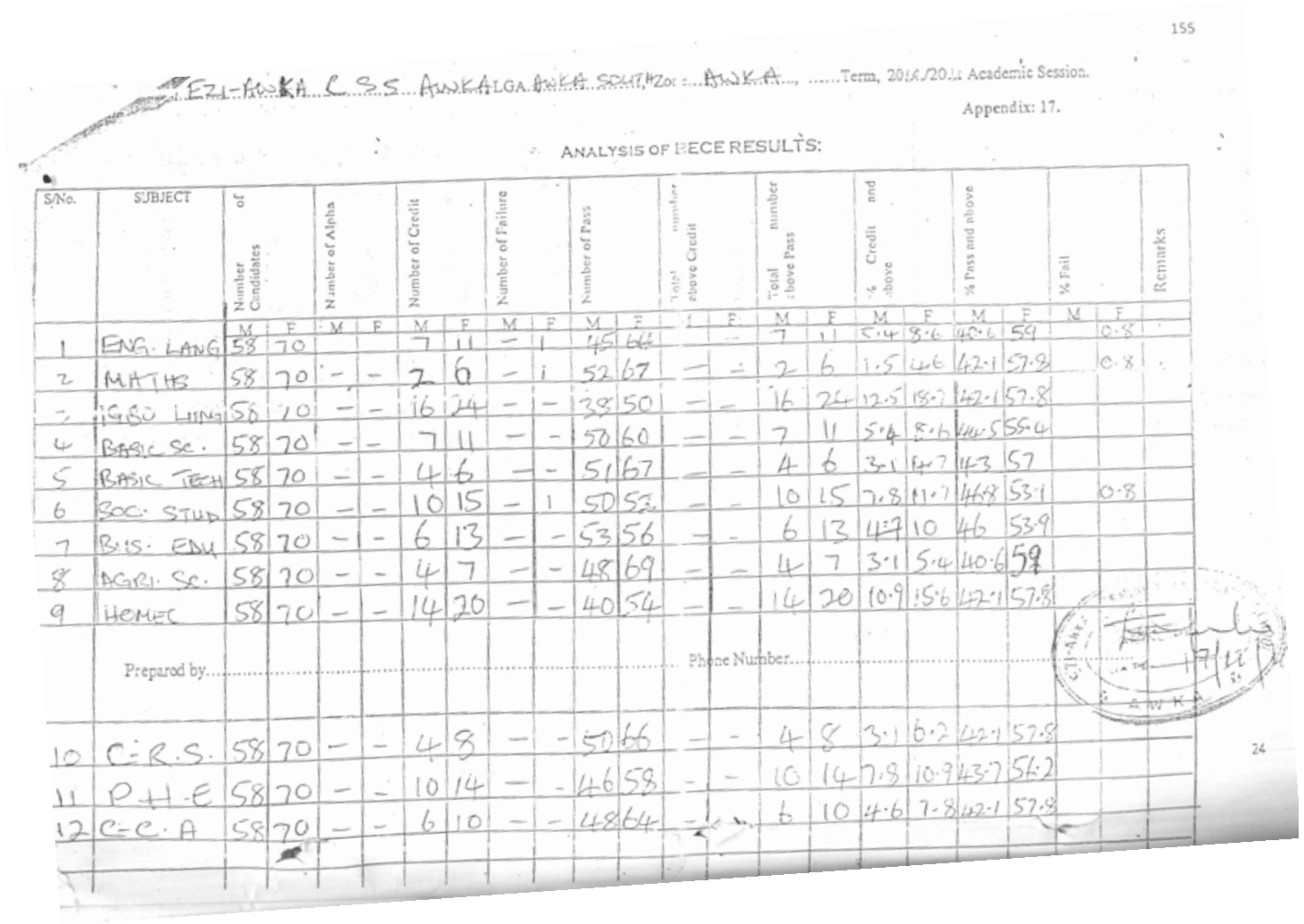
2011/2010

Umeogu, J.K.J

(Principal)

SUBJECT	NO OF CANDIDATES	NO SAT	NO OF As	% OF As	NO OF Cs	C+A	% OF C+A	NO OF Ps	% OF Ps	NO OF Fs	% OF Fs	REMARK
NGLISH LANGUAGE	112	110	2	2	47	49	44.5	61	55.5	—	—	
MATHEMATICS	112	110	—	—	15	15	13.6	94	85.5	1	0.9	
BASIC SCIENCE	112	110	1	0.9	42	43	39.1	67	60.9	—	—	
BASIC TECHNOLOGY	112	110	—	—	50	50	45.5	59	53.6	1	0.9	
ASIC STUDIES	112	110	—	—	44	44	40	65	59.1	1	0.9	
IGBO	112	110	—	—	49	49	44.5	60	54.5	1	0.9	
BUSINESS STUDIES	112	110	—	—	50	50	45.5	59	53.6	1	0.9	
RIC. SCIENCE	112	110	—	—	28	28	25.5	82	74.5	—	—	
HE ECONOMICS	112	110	1	0.9	50	51	46.4	59	53.6	—	—	
CRS	112	110	—	—	48	48	43.6	62	56.4	—	—	
PHE	112	110	—	—	42	42	38.2	67	60.9	1	0.9	
NE ART	86	79	2	3	34	36	45.6	42	53.2	1	1.3	
MUSIC	22	22	3	14	10	13	59.1	10	45.5	—	—	

Appendix E: Summary of 2011 JSSCE Result in Mathematics



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EZI-AWKA C.S.S. AWKA ALGA AWKA SOUTH Zone AWKA ..... Term, 2010/2011 Academic Session.

Appendix: 17.

ANALYSIS OF BECE RESULTS:

S/No.	SUBJECT	Number of Candidates		Number of Alpha		Number of Credit		Number of Failure		Number of Pass		Total number above Credit		Total number above Pass		% Credit and above		% Pass and above		% Fail		Remarks
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
1	ENG. LANG	58	70			7	11	–	1	45	66			7	11	5.4	8.6	40.6	59		0.8	
2	MATHS	58	70	–	–	2	6	–	1	52	67	–	–	2	6	1.5	4.6	42.1	57.8		0.8	
3	IGBO LANG	58	70	–	–	16	24	–	–	38	50	–	–	16	24	12.5	18.7	42.1	57.8			
4	BASIC SC.	58	70	–	–	7	11	–	–	50	60	–	–	7	11	5.4	8.6	40.5	55.4			
5	BASIC TECH	58	70	–	–	4	6	–	–	51	67	–	–	4	6	3.1	4.7	43	57			
6	SOC. STUD	58	70	–	–	10	15	–	1	50	53	–	–	10	15	7.8	11.7	46.8	53.1		0.8	
7	BUS. EDU	58	70	–	–	6	13	–	–	53	56	–	–	6	13	4.7	10	46	53.9			
8	AGRI. SC.	58	70	–	–	4	7	–	–	48	69	–	–	4	7	3.1	5.4	40.6	59			
9	HOME EC	58	70	–	–	14	20	–	–	40	54	–	–	14	20	10.9	15.6	42.1	57.8			
	Prepared by..... Phone Number.....																					
10	C.R.S.	58	70	–	–	4	8	–	–	50	66	–	–	4	8	3.1	6.2	42.1	57.8			
11	P+H.E	58	70	–	–	10	14	–	–	46	58	–	–	10	14	7.8	10.9	43.7	54.2			
12	C.C.A	58	70	–	–	6	10	–	–	48	64	–	–	6	10	4.6	7.8	42.1	57.8			

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