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Analysis of co-operative learning technique on improving teaching and learning of mathematics among grade elevens. (Focus study of Fatima girls' secondary school of Ndola district)

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Abstract
Several studies and reports have indicated that a lot of learners are underperforming in mathematics. The underperformance of learners in mathematics is very concerning and has evoked research interests into teaching strategies that can be used to improve the performance of learners in mathematics. This study investigated the analysis of cooperative learning strategy on teaching and learning of mathematics among grade elevens. A mixed method approach specifically quasi-experimental research design with equivalent control group and interviews were used to collect data. The population for the study composed of grade elevens learners from Fatima girls secondary school of Ndola district. The sample consisted of seventy six (76) learners from two purposively selected classes of the same academic ability. Both quantitative and qualitative approaches were applied in the data collection and analysis. SPSS and Excel were used to analyse the data collected. The post-test mean for the experimental group changed from the pre-test mean by 14.81%, while in the control group the change from the pre-test to post-test mean was 6.39%. Based on the analysis and interpretation of the data collected in this study, the conclusion reached was that learners taught using cooperative learning performed better in mathematics than learners that were taught using traditional teaching method. The results also revealed that those students who were taught using cooperative learning instructional strategy resulted in better performance in mathematics than traditional teaching method. In addition, learners expressed an increased interest, motivation and self-efficacy after exposure to cooperative learning. The study recommended further that cooperative learning to be integrated with conventional teaching method when learning mathematics.

Keywords: cooperative learning, student team achievement, performance, motivation, learner and achievement test

1. Introduction
The Zambian Government attaches great significance to the teaching of Mathematics in Zambian schools. "Mathematics is indispensable for the development of science, technology and commerce". Mathematical skills, knowledge, concepts and processes, enables the individuals to investigate, model, and interpret numerical and spatial relationships and patterns that exist in the world. Mathematics is one of the most interesting and developmental subjects that should be enjoyed by both the subject teacher as well as the learner as human life is never short of basic application of mathematical concepts (Changwe. R and Mwanza. C, 2019). Mathematics is also an entry requirement at tertiary institutions for courses such as medicine, geology, engineering and information technology and Zambia needs experts in these fields in order to accelerate development and economic growth. The value attached to Mathematics led the policy implementers to subject it to compulsory subject for every child in Zambian schools. Despite this being the case, the Examinations Council of Zambia (ECZ) (2016) report indicated that the performance of learners in mathematics countrywide had continued deteriorating.

Ministry of Education admits that the poor performance in Mathematics is a real challenge. The Ministry of Education Science Vocational Training and Early Education (1996, p.54) says that "clearly, there is a situation here which requires urgent attention and major intervention by the pupils themselves and the country as a whole cannot sustain a continuation of the unsatisfactory performance in Mathematics. The under performance by pupils at School Certificate level has been going on for quite some time now without any tangible solution being realized by the Ministry of Education Science Vocational Training and Early Education to reduce the trend. Pupils themselves and the Mathematics teachers are believed by the Ministry of Education Science Vocational Training and Early Education to be the ones perpetuating this situation. Therefore, to identify the root cause there is urgent need to carry out a research in the way teachers can be helped to find the suitable method of learning Mathematics in Secondary Schools in Zambia. This problem seems not to have attracted the research attention that it deserves and little or no knowledge is known so far of its' causes.

Iyambo (2010) urges teachers to motivate their learners to study Mathematics and be able to further their education in science related fields such as geology, engineering and Information Technology. Phillip (1999) justifies that when students work in a small group (3 to 4 learners) with their peers it provokes discussions about plausible choices on different strategies to solve a problem, and necessitates a discussion on the merits of those strategies if one approach is to be settled on. When a student works on a problem alone, the first plausible option is most likely to be chosen and the discussion on the merits of different approaches which should take place internally, may not take place (Phillip, 1999). The decline of performance in school subjects might be due to the lack of motivation in learners and for this reason one area that has been overlooked for a long time is the failure by curriculum designers as well as curriculum implementers to relate mathematics to real life

experiences of the learner by in cooperating the learners into the learning process fully. This has led to most of the Zambian learners to look at mathematics as an imported subject area from abroad who would simply learn and pass it to meet the requirements of the country's education system (Sakayombo, 2018). Cobb (2005) argues that when learners work cooperatively, they share their ideas and listen to other learners‟ perspectives, seek new ways of clarifying differences, resolving problems, and constructing new understandings and knowledge. The result is that students attain higher academic outcomes and are more motivated to achieve than they would be if they worked alone.

2. Statement of the problem

The issues in Mathematics education in Zambia according to Nakawa (2010, 2012) and Nonaka (2013) have indicated that students in Zambia have very low performance due to teachers' inadequate use and competence in the understanding of some of the methodologies to put in place and their limited views on Mathematics lessons. Nakawa (2010) has also indicated that students' low achievement is a major issue in Mathematics education. This state of affairs has not pleased the Ministry of Education, Science, Vocational, Training and Early Education. The Ministry of Education, Science, Vocational, Training and Early Education through their document Educating Our Future (1996, p.25), observed that, "the overall unsatisfactory performance in the School Certificate Examination is attributed, to a large measure to poor performance in Mathematics." Although more teachers that are qualified continue to be recruited and deployed in various schools in Copperbelt Province, pupil performance levels especially in Mathematics at School Certificate are still low.

Pupils' failure should not only be attributed to them or teachers alone but also on the way in which a particular teaching methodology is being applied. Most of the learners complain that mathematics has proved to be the most difficult subject hence making it very difficult to achieve the intended goals of helping themselves. Usually teachers use teaching styles that involve chalk and talk for a long period as they teach their classes. The students watch, listens, and copy what the teacher does observably; students generally have difficulties in listening and copying problems from the board at the same time (Musonda *et al*. 2012). Based on researchers' experience in Zambia especially in the teaching of mathematics, some teachers spend more time on teaching computational skills rather than engaging the students in mathematically rich problem-solving experiences as their preferred teaching styles. The problem is that there is poor learning achievement in as far as teaching and learning of mathematics is concerned. This is because individual learning creates a competitive learning environment in which only few individuals achieve their goals and believe they have a chance to perform better (Banda G, 2018) [9]. As stated earlier it is difficult for pupils to understand the mathematical concepts clearly. As a result they fail to get the application of the topics and the mathematical concepts taught. In this case the researcher to employed the use of cooperative learning and analyse its effectiveness on teaching and learning of the mathematics concepts among grade Elevens.

3. Research objectives

The study sought to address the following objectives

1. To analyse the effectiveness of the use of cooperative learning in teaching and learning of Mathematics concepts at Fatima Girls secondary school.
2. To determine if there is a difference in the attitude of Mathematics students who have been taught using cooperative learning compared to individualistic learning strategies at Fatima Girls secondary school.

4. Research questions

The following were the research questions

1. How effective is cooperative learning in teaching and learning of mathematics concepts at Fatima Girls secondary school?
2. What are the learners' attitudes toward cooperative learning technique compared to individualistic learning strategies at Fatima Girls secondary school?

5. Research Hypotheses

H_0: There is no significant difference between the performance of the Grade 11 Mathematics learners taught using cooperative learning and those taught using individualistic learning strategies.

H_1: There is significant difference between the performance of the Grade 11 Mathematics learners taught using cooperative learning and those taught using individualistic learning strategies.

6. Significance of the study

According to Roth and Roychoudhury (1993:143) cooperative learning is the convenient way to support the construction of individual knowledge of the members in a variety of ways. when learners are required to explain, elaborate, or defend their position, they construct a deep understanding because they have to evaluate, integrate, and elaborate upon their existing knowledge.

The study is vital in Mathematics education in three ways. Firstly, it could provide information to Mathematics teachers on why pupils lose interest and develop negative attitudes in learning Mathematics so that they can take steps to instill interest and positive attitudes toward learning Mathematics by initiating cooperative learning model. Secondly, it may provide information to the Ministry of Education, Science, Vocational, Training and Early Education about this learning model (Cooperative learning) and find ways in which Mathematics teachers can be assisted by means of Continuous professional development (CPD) at both school level and District level as well as help formulate programs and policies that foster interest and positive attitudes. Lastly, the findings of this study will contribute to the existing Mathematics education literature and provide information for further studies.

7. Review of literature

7.1 Cooperative learning

Active learning is a category of pedagogies established as being extremely effective in engaging and maintaining student interest, thereby leading to better student performance and retention of subject matter. The

responsibility for learning is focused on the learner. Many active learning strategies involve some form of group work. Group work covers all kinds of multiple-person active instructional activities along formal – informal, thereby parsing out as "cooperative". cooperative learning has been defined as small groups of learners working together as a team to solve problems, complete task or accomplish a common goal" (Artz & Newman, 1990:448) [4]. The cooperative learning model requires student cooperation and interdependence in its task, goal and reward structures. The idea is that lessons are created in such a way that students must cooperate in order to achieve there learning objectives.

Cooperative learning, in addition to impacting academic achievement, also positively influences attitudes of and towards students with disabilities. Cooperative learning's effects on attitudes are evidenced by increases in self-esteem, social acceptance, and teacher ratings of students with disabilities (Putnam, Markovchick, Johnson, & Johnson, 1996). Cooperative learning has also been used as a vehicle to guide and shape student behavior (Johnson & Johnson, 1975). Cooperative learning also promotes creative thinking by increasing the number of ideas, quality of ideas, feelings of stimulation and enjoyment, and originality of expression in creative problem solving (Bahn, 1964; Bolen & 'Thrrance, 1976; Dunnette, Campbell, & Jaastad, 1963; Ehlk & Johnson, 1977; Peters & 'Ibrrance, 1972; Thrrance, 1970, 1971, 1973; Triandis, Bass, Ewen, & Mikesell, 1963). (Johnson and Ahlgren, 1976) [6] examined the relationships between students' attitudes toward cooperation, competition, and their attitudes toward education. The results of the study indicated that student cooperativeness, and not competitiveness, was positively related to being motivated to learn. (Humphreys, Johnson, and Johnson, 1982) also found that students studying physical science in a cooperative learning treatment group rated their learning experience more positively than did students in competitive and individualistic treatment groups. (Tjosvold, Marine, and Johnson, 1977) found that cooperative learning strategies promoted positive attitudes toward both didactic and inquiry methods of teaching science, and students taught by cooperative strategies believed they had learned more from the lesson than did students taught by competitive strategies. In a study involving elementary and secondary students who were taught nutrition,

The perspective of cooperative learning has also been done in Zambian context by some researchers as Cooperation is the key for group success. It is through cooperation that the group is able to achieve its goals. In most cases, cooperation has to be learned, and once learned it will enable the student to better adapt to the world outside and after school. Competition, on the other hand, is found to be anti-productive by the students of the group. For example, when the task involves complex learning and problem solving skills, several psychologists have found that cooperation leads to high1er achievement than competition. In a well-structured cooperative learning setting, the students rarely make negative comments to one another and tend to discuss topics related to the material. However, traditional classrooms are set-up not to promote any cooperative learning or cross-racial or cross-ethnic relations but are set up to promote individualization and disregard any of the benefits outlined in cooperative learning. Cooperative learning appears to have beneficial effects on learning and motivation in the classroom. What are some ways in which cooperative learning can be implemented into the classroom? Since cooperative learning involves small groups, the small group can be used to make teams.

According to the study conducted in Kitwe at Chibote Girls Secondary by, Kamanga Judith (2014) on the Comparative study of the Effectiveness of Cooperative Learning Strategy and Traditional instructional Method in the Physics Classroom highlighted that Cooperative learning strategy in the physics classroom does increase pupil's academic achievement as well as pupil's motivation to learn than traditional instructional method. Therefore she recommended cooperative learning. To be adopted at all level of education because of its emphasis on social instruction among the pupils in the classroom and most especially because of its impact on improved academic performance.

The study also revealed that the Cooperative learning strategy class (Experimental group) outperformed the Traditional instructional method class (control group) in the physics test and the difference in their academic achievement was found to be significant before and after controlling pre -test. However, the performance for both groups was generally below average. Furthermore, The mean scores on pupils motivational levels to learn revealed that the Experimental group was highly motivated whereas the Control group was only fairly motivated and their motivational levels to learn was significantly different before and after controlling pre-motivational survey. This study revealed that Cooperative learning strategy is more effective than traditional instructional method. This finding is in line with that of Zemke, Elger & Beller (2004) who found that students overwhelmingly indicated that the use of effective events enabled them to more easily master different material in cooperative learning group. He further stated that those students who worked in smaller groups i n cooperative learning strategy were better motivated to learn physics, this might be as a result of better accessibility to the teacher during teaching and learning process than in the Traditional method class.

Banda G and Musonda A (2018) [9], Further Recommended that Cooperative learning technique is integrated with traditional teaching method in the teaching of statistics. During peer teaching, students should incorporate cooperative learning approach. This will ensure that student teachers are well grounded on effective teaching and learning approaches for higher academic achievement in mathematics which are the cornerstone for development of the country. The use and implementation of cooperative instructional strategy in the classrooms be strengthened in the methodology courses of student teachers at Mukuba University.

8. Methodology

8.1 Research methodology

Orodho (2009) defines methodology as the scheme plan used to generate responses to research questions. Furthermore, research methodology refers to the techniques used to structure the study, gather and analyse information in a systematic way (Kombo 2006). The methodology describes research design that could be used, target population, sample size, sampling procedures and research instruments. It also describes the data collection procedures and how the data may be analysed in order to answer the research questions.

8.2 Research design

A research design is a plan of the proposed research work. Kothari (2004) explains that a research design is a pre-plan of the methods that are to be used for the data collection. It takes account of techniques to be adopted in the analysis, while adhering to research objectives, time or monetary resources available. Ghosh (2003) [22] points out that a research design is not a rigid plan to be followed without deviation, but a series of flexible guide posts to help the research maintain the focus of the study. Kombo and Tromp (2006) define a research design as the scheme, outline or plan that is used to generate answers to the research problems. According to Bless and Achola (1983), the research design provides answers to such questions as: What kind of sampling will be used to gather data? How will time and constraints be dealt with?. Seidu (2007), postulates that a research design describes the procedures and methods used to gather data. Seidu adds that research design lists and describes the instruments used to collect data.

Therefore, the research design adopted for this study was quasi-experimental control group interrupted time series design involving pre-observation (pretest) and post-observation (posttests). In this design, two treatments were compared with two experimental groups. Accordingly, the students were randomly assigned to each of the teaching methods, namely, individual learning (IL) taken as the control group and the experimental group (cooperative discussion group).

8.3 Target population

According to Moulton (2014), "a population is a collection of objects, events or individuals having some common characteristic that the researcher is interested in studying". The research will be conducted in Kavu ward of Bwanamkubwa constituency in Ndola district. There are three schools in this particular ward. The school which the researcher will target for data collection is Fatima Girls' secondary School was picked purposively. The researcher stays within the same catchment area which is near by the stated school and will be the primary source of the data collection.

The capacity and spread of the targeted school is the secondary school which is the boarding school with roughly 520 pupils from grade 8 to 12. However, the research will automatically be conducted specifically to the grade 11s of Fatima Girls secondary school because the researcher is in close in contact with the grade elevens at the time of the research study.

8.3.1 Sample size

A sample is a subset of a population that is used to represent the entire group as a whole (White, 2014). It is for this reason that every researcher needs to come up with a good and manageable sample representation of the population (Changwe, 2017). The target population for the study was 82 respondents of which 6 were teachers and 76 Grade Eleven pupils of mixed abilities of Fatima Girls' Secondary School that will be picked purposively.

8.3.2 Sampling techniques

Convenience sampling technique was used because it is inexpensive and participants are readily available (Castillo, 2010). In addition, Ferrance (2000) argued that research studies conducted by educators themselves, in a familiar school setting, with their own learners, would help solve real problems experienced in schools and thus contribute towards improving teaching and learner achievement.

8.3.3 Data Collection Instruments

The main research tools used in the study were questionnaires. According to Orodho and Kombo (2006, 2009), research instruments include learners pre-test and post-test answer scripts, questionnaires and interview schedules. Brown (2001) [13] defines a questionnaire as any written instrument that presents respondents with a series of questions or statement to which they are to react either by writing out their answers or selecting from among existing answers. Therefore, Questionnaires will be used as one of the instruments for data collection. In-depth interview guide will be administered to the key informants being the Teachers. Kombo and Tromp, (2006) points out that interview allow the researcher to get more in-depth information from the key informants about an issue under investigation. For this reason, the Semi structured Interview Schedules and Pupils pre-test and post-test scripts will also be used for data collection as stated earlier as well as Classroom discussions which will be used to assess student's attitudes towards the proposed learning model.

8.4 Data Collection Procedures

Cresswell (2009) elucidates that in order to collect, analyze and interpret data in a research, research methods are used. Wall (1986:70), defines data as numbers or symbols assigned to characteristics of objects or events. Therefore, with this regard, Questionnaires were distributed to learners and collected back after one week. Semi structured Interview Schedules were also distributed to learners after the intervention and latter collected and analyzed.

8.4.1 Data Analysis

The researcher started the process of data analysis as soon as the research was accomplished. In this study, both cases, that is, qualitative and quantitative data analysis were used, respectively.

8.4.2 Thematic analysis

Thematic analysis is a method of identifying, interpreting and coming up with themes of the qualitative data (Braun & Clark, 2006) [12]. Hence, several themes pertaining to the students' views towards the cooperative learning technique will be derived from the analysis.

8.4.3 Data Analysis

In line with qualitative data analysis, Kombo and Tromp, (2006, 2009), urge that, 'the responses can be categorized into various classes which are called categorical variables,' and adds that, 'in qualitative research, data can also be analyzed mathematically. Themes refer to topics or major subjects that come up in the discussion.

This form of analysis categorizes some related topics.' Qualitative data were analyzed by content analysis. Content analysis is the systematic qualitative description of the composition of the objects or materials of the study (Mugenda and Mugenda, 2015). The data were analyzed by using the pie-chart, tables, Histograms, graph and statistical measures such as percentages. This helped to summarize and describe variables stated, such as, frequencies of common response of the respondents. And the structured

data was used to analyze through content analysis in order to understand consistence of information from various respondents. Therefore, the results were presented using frequencies, pie-chart, tables, graphs as well as percentages.

8.4.4 Validity and Reliability

It was important to ensure validity and reliability. Kombo (2009) defines validity as the integrity of conclusions that are generated from the research findings. Validity refers to the degree to which a measure truly reflects the phenomenon under study. It is about the closeness of the findings and the situation to show whether the method used in the study provides information in line to what it intends to investigate. In this study validity was observed by recording and analyzing the data accurately.

Reliability is the extent to which measures produce consistent result. Kothari (2004) stated that reliability was the degree of accuracy or agreement between two independently derived sets of score and the extent to which independent administrators of the instruments yielded the same or similar under comparable conditions. The findings had to be transcribed well, recorded and presented as meaningful findings. In this study reliability was observed by transcribing the recorded data accurately as meaningful findings.

9. Data presentation and analysis

9.1 Introduction

This Chapter presents the presentation and results of the research findings. The presentation of the findings and discussion addressed the three research objectives based on the analysis of cooperative learning techniques to improve teaching and learning of mathematics at Fatima Girls' Secondary School. The views of Teachers and pupils' perception on cooperative learning will also be discussed and learners experience towards this kind of learning will be analyzed. The findings are based entirely on Grade Eleven pupils of Fatima Girls Secondary School located in Ndola district. The chapter therefore will present the data analysis in graphs, tables as well as charts.

Analysis of pupil's questionnaire 4.11 Influence of Cooperative learning on attitude towards academic work

9.2 The pretest and posttest results analysis

This study basically investigated the analysis of the impact of the uses of cooperative learning on teaching and learning mathematics. It was designed as an experiment in which the teaching strategy was the independent or the manipulated variable and the performance of learners the dependent or measured variable. Participants in the study consisted of 76 Grade Elevens of Fatima Girls' Secondary School. Learners from two classes were purposively selected. The participants were divided into experimental and control group, with each group consisting of 38 learners.

At the beginning of the study, both the experimental and control group were pretested with Mathematics achievement test (MAT). This was done to establish whether significant difference in academic ability existed between the groups before the start of the study. The study or treatment period lasted for four weeks during which the experimental group was taught using cooperative learning and the control group taught using traditional teaching method.

The topics covered in both groups were the same and focused on the following Mathematics topics: Mensuration, Circle Theorem and Arithmetic and Geometric progressions. In order to determine the impact the different teaching strategies had on the performance of the learners, both the experimental and control group were tested (Posttest) after the intervention (cooperative learning strategy on experimental group). The table on Apendix F represents the pretest and posttest scores of learners in the experimental and control group. The pretest score reflects the scores achieved by learners in the mathematics test at the beginning of the study while the posttest score is the score achieved by learners at the end of the 8 weeks treatment period. The questions in the posttest were based on the topics that were covered in both the experimental and control group.

9.2.1 Analysis of pre-test scores before intervention

Descriptive statistical analysis transforms a set of numbers or observation into indices that describe or characterize the data. It uses mathematical formulae to organize and reduce large quantities of observation into a few numbers which represent the observation in each group of interest (McMillan & Schumacher, 2010: 149). The analyses below show the descriptive statistical analysis of the pretest and posttest scores of the experimental and control group.

Before the intervention was introduced, a test was given to learners. After the intervention, another test was given to the learners. The two tests were assigned individually. The number of participants was 76 from both the control and Experimental groups. The results of the pre-test were compared using descriptive statistics. The SPSS package was used to come up with the descriptive statistic results as shown in the tables below

9.2.2 Descriptive statistics for pre-test results of the Control group and Experimental group

Table 4.22

Descriptive statistics of pre-test			
		CN Group (pre-test)	**NCT Group (pre-test)**
N	Valid	38	38
Mean		58.03	59.61
Median		61.00	60.00
Std. Deviation		14.871	13.834
Minimum		20	31
Maximum		86	87

From table 4.22, it can be seen that the pretest mean scores of the experimental and control group was almost the same (58.03% for the experimental group and 59.61% for the control group). This does suggest that both the experimental and control group were matched in terms of academic ability at the beginning of the study. The tests lasted for one hour 30 minutes and were written under the same condition in both the experimental and control group. The scores obtained by learners in the tests were used as a measure of their performance in mathematics

9.2.3 Analysis of pre-test scores after intervention

9.2.4 Descriptive statistics for post-test results of the control group and experimental group after intervention

Table 4.24

Descriptive statistics of post-test			
		CNT Group (post-test)	NCT Group (post-test)
N	Valid	38	38
Mean		64.42	74.42
Median		69.00	76.50
Std. Deviation		15.566	13.620
Minimum		32	47
Maximum		87	95

The table above shows that the posttest means score for the experimental group (NCT Group) was 74.42%, while that of the control group (CNT Group) was 64.42%. Since both groups were matched in terms of academic ability at the beginning of the study, any differences in the post-test mean scores could be attributed to the teaching strategies that were used in the experimental and control group during the course of the study. The result of the mathematics test was further analyzed to determine the levels achieved by learners in the experimental and control group using standard deviation and skewness.

9.2.6 Descriptive statistics of the pre-test and post-test of the Control group.

Table 4.26

	Control group	Pre-test	Post-test
N	Valid	38	38
Mean		58.03	64.42
Median		61.00	69.00
Mode		70	74[a]
Std. Deviation		14.871	15.566
Skewness		-.770	-.655
Std. Error of Skewness		.383	.383
Range		66	55
Minimum		20	32
Maximum		86	87

The above table shows the descriptive statistics of the pre-test and post-test of the Control group.it can be noted that the maximum score of the pre-test was 86 and that if the post test was 87. This shows that there is not much improvement in the performance even though the minimum score has improved from 20 to 32 for the pre-test and the post-test respectively.

9.2.7 Descriptive statistics of the pre-test and post-test of the Experimental group.

Table 4.27

		Pre-test	Post-test
N	Valid	38	38
Mean		59.61	74.42
Median		60.00	76.50
Mode		60	78
Std. Deviation		13.834	13.620
Skewness		.001	-.347
Std. Error of Skewness		.383	.383
Range		56	48
Minimum		31	47
Maximum		87	95

In the descriptive statistics shown above, the mean value before implementation of the intervention was 59.61 % and that attained in the post-test was 74.42%. The median being the score found at the middle of the set of values, such that has as many cases with a larger value as there are smaller values, the median value of the pre-test was 60%, this tells that more than 50% of learners scored less than 60% in the pre-test compared to the post-test median value of 76%, which implies that more than 50% of the learners scored above 76% showing the greater improvement.

9.2.8 Histogram for the control group of learner's performance of findings in pre-test.

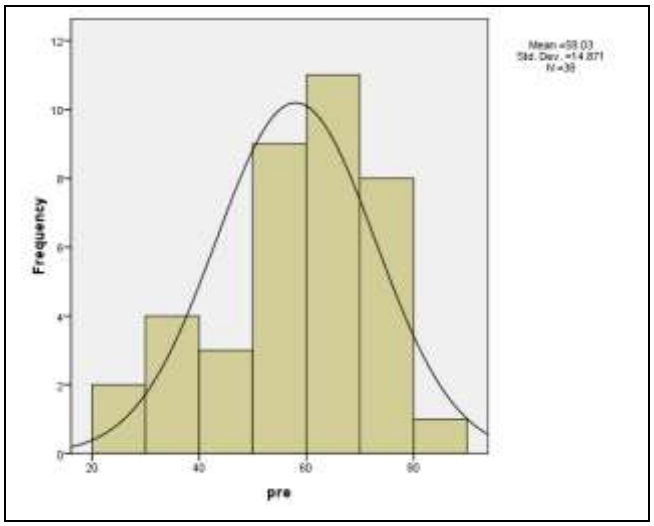

Fig. 4.28

9.2.9 Histogram for the control group of learner's performance of findings in post-test.

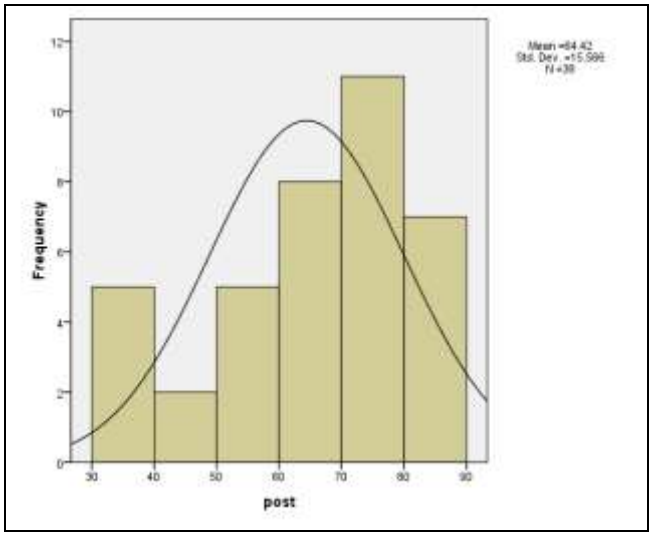

Fig. 4.29

The Standard deviation being the value which shows the dispersion there is from the mean, the pre-test standard deviation value is 16.76148, and that for the post-test is12.91365. The low standard deviation obtained in the post-test indicates that the set of scores are very close to the mean and the high standard deviation obtained in the pre-test indicates that, the set of scores of the pre-test are spread out over a large range.

9.3 Histogram for the Experimental group of learner's performance of findings in pre-test

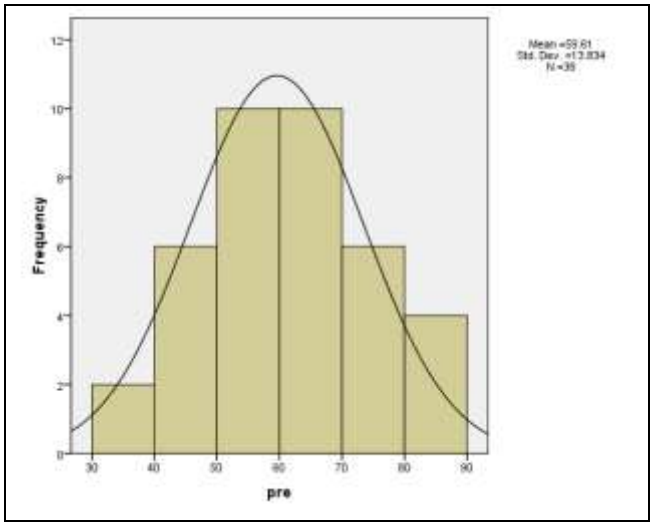

Fig. 4.30

9.3.1 Histogram for the Experimental group of learner's performance of findings in post-test.

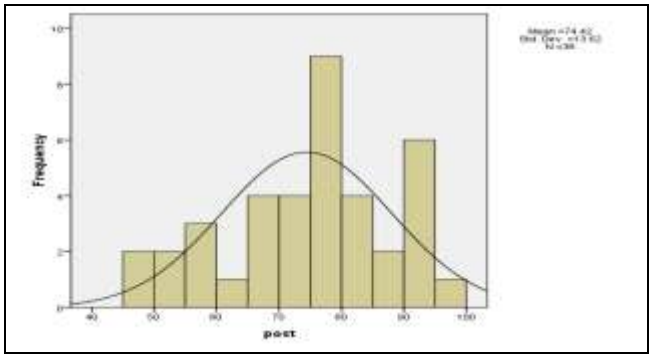

Fig. 4.31

Figures 4.30 and 4.31 shows the histogram for the pre-test and post-test scores of the experimental group. The histogram for the pre-intervention in figure 15 shows that out of a total number of 38 learners, 19 of the learners scored marks below the mean value of 40.2 and 19 above mean value. Likewise, out of a total number of 39 learners, 28 of the learners scored marks below the mean value of 61.68 and 10 of the learners scored above the mean value.

9.3.2 Difficulties faced by the pupils

Generally the performance of learners in the pre-test was not good. From the samples of the answer scripts shown above the following mistakes could be noted.

1. Computational weaknesses

Some of the pupils had a problem with computation. They could write the correct formula but find difficulties to compute.

2. Forgetting and failure to coordinate concepts

Recalling of prior knowledge is another factor that the pupils had a problem with. Some of the tasks that were asked in the pre-test required the pupils to recall, if he is to get it right. This was noticed from the answers the pupils were giving, some pupils had brilliant ideas but failing to coordinate concepts from the prior knowledge in order to arrive at the needed solution or answer.

3. Lack of confidence and self esteem

As marking of the pre-test was done, it was discovered that some pupils lacked confidence and self-esteem. It was found that some pupils would begin answering a task with a very correct step, but as they proceeded in their solving, they lost focus and ended up with wrong answers. These include individual exercises, group work and post-test answer scripts.

10. Data analysis and research discussion

Effectiveness of the use of cooperative learning when teaching Mathematics concepts

From the findings the pre-test mean scores of the experimental and control group before intervention was almost the same (58.03% for the experimental group and 59.61% for the control group). This does suggest that both the experimental and control group were matched in terms of academic ability at the beginning of the study. The post-test mean for the experimental group changed from the pre-test mean by 14.81%, while in the control group the change from the pre-test to post-test mean was 6.39%. Based on the analysis and interpretation of the data collected in this study, the conclusion reached is that learners taught using cooperative learning performed better in mathematics than learners that were taught using traditional teaching method.

The findings of this study are very significant and support the effectiveness of cooperative learning as a teaching strategy. It has several implications for educators and other stakeholders in education with regards to teaching strategies that can be used to enhance the performance and motivation of learners in mathematics. The extent to which learners learn depends on their level of motivation which can be stimulated by the nature of the learning environment and the teaching strategy adopted by the teacher (Mwamwenda, 2004: 235). The use of cooperative instructional strategy captured the attention of the learners in the experimental group. The novelty idea of working in small heterogeneous groups increased their motivation, self-efficacy and made learning very exciting.

While the research result supports the effectiveness of cooperative learning as a teaching strategy, it does not suggest that traditional or conventional teaching method is ineffective. Rather, it makes a case for cooperative learning to be integrated with conventional teaching method. The researcher is of the view that continuous dependence or use of the same teaching methodology could bore learners and make them lose interest in the lesson. As the researcher taught both the experimental and control group, he did observe the sense of excitement of the learners that were taught using cooperative learning. This contrasted sharply in the control group that was taught using traditional teaching method. This is not to say that learners in the control group were bored, they were simply used to traditional teaching method. They could not see any difference between the method used in the study and the method with which they have been receiving instructions. The findings of this study do suggest that cooperative instructional strategy could be one of the avenues or strategies that could be used to enhance the performance and motivation of grade 11 learners in mathematics.

11. Learners' attitudes toward cooperative learning compared to individualistic learning strategies.

Only 56% of the students indicated that they would be more comfortable if Teachers utilized cooperative learning. Pupils, who indicated that they would not be really comfortable, gave reasons such as fellow students not pulling their weight during their group discussions, conflicts of interest among pupils themselves as well as individuals not willing to participate in group activities. From an assessment of students' questionnaires 35% of students strongly agreed that they willingly participate in group activities, 40% agreed, 15% disagreed and 10 % strongly disagreed with the statement. It is natural that some students are apprehensive about cooperative learning because of their fear of failure and its perceived limited value.

It not unusual for students to be place a low value on cooperative learning techniques, Lake (2001) as cited in Rans dell and Moberly (2003) reports that students see this alternative teaching style (cooperative learning) as unscholarly; rather akin to unstructured group work where one student works diligently, to carry the group, and the others do little or nothing. Many students hold this view of cooperative learning this was brought during the interview in which one Teacher indicated that in one of her classes students were overheard saying "I don't think Mr knows what He's doing; this obviously is for us to just waste time." During the class observation a student was heard saying "this is not going to be graded so I don't have to do it."

64.4 % of the pupils indicated that they would be comfortable if group activities were incorporated in learning Mathematics. It must be noted that even though students would be comfortable if group activities were incorporated in their course of study. One Teacher stated that enabling students to choose their own group members has helped to lessen students' apprehension towards group work. This would mean that students would be able to choose other individuals who they are comfortable working with. If two principles of cooperative learning: individual accountability and group processing are followed they could address some of the students' concern about learning mathematics and their final result. Each student is held accountable for completing his or her own work and thus should be given an opportunity to confidentially report on the actions of other group members.

12. Summary, conclusion and recommendations

12.1 Conclusions

Based on the findings the following conclusions have been derived:

It is clear in spite of the potential benefits of cooperative learning it is not fully accepted by all students at the institution. Due to students fear, apprehension and past experiences many prefer to work on their own rather than within a group. On the other hand, it is evident that whenever students are a part of cooperative learning activities or assignments whether within the classroom or outside there is an improvement in their level of class participation and academic performance. The findings suggest that student believe that cooperative learning facilitates good working relationships, and enhances socialization and creativity. Based on the findings, it is evident that a more informal cooperative learning technique is practiced at the institution. It is evident that cooperative learning is an underutilized tool. It is noted that students and lecturers are not fully aware of the various cooperative learning techniques that can be utilized.

The results of the study revealed the significance of cooperative learning in bringing a major change in the existing traditional method of instruction. Based on the findings of the study, cooperative learning is both an enjoyable and effective teaching strategy and result in significantly higher learning gains and positive learning experience compared to traditional instruction. It provided the students opportunity to interact with their classmates and such interaction develops in them feelings of cooperation and care for others.

The results of the present study are in line with the previous studies by Slavin (1996), Tanner and Marr, (1997) whose studies showed that cooperative learning models has a significant effect on academic achievement of students. The findings of the present study are also in agreement with the findings of the study by Chiason, Okwu & Kurumeh (2010) who found a high, level of achievement difference between students taught circle geometry using cooperative learning strategy and conventional learning strategy. The result of the present study is also in line with the previous studies of Akinbobola (2006) [2] whose study revealed that students taught using the cooperative learning method performed better than those taught using the conventional method. Furthermore, cooperative learning model enables learners to receive positive feedback from the process of thinking, problem solving and group interaction, hence this results in better skills and comprehension of the educational concepts as well as in task sharing.

12.2 Recommendations

1. An encouragement in the form of workshops should be organized on cooperative learning strategy for teachers who want to implement CL in their regular classroom lessons.
2. Mathematics teachers should be sensitized and encouraged to use practical, child centered, activity-based and problem-solving methods of teaching mathematics such as the cooperative learning approach.
3. The traditional instruction should not get rid of radically, rather wise use and suitable time should be taken to gradually replace it by cooperative learning.
4. Teachers who are willing to implement this strategy should be prepared, patient, skillful, perseverant, and flexible so as to practice to reach teaching goals in current society.
5. The Ministry of Education and head of schools should ensure that teachers implement the use of cooperative learning to assess their students in schools because it involve team work which is linked to self-direction and boost confidence. This will help the students to communicate their and share their skills of solving problems with each other.

13. References

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