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Cooperative Learning: A Comprehensive Approach in Enhancing Students' Competencies in Solving Word Problems Involving Algebraic Linear Equations

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Abstract

This paper investigated the impact of the cooperative learning approach on the performance of level 100 students in mathematics using some selected students from Akrokerri College of Education. Forty-two (42) students were selected from the level 100 students offering Bachelor of Basic Education in the institution. A quasi-experimental research design was used and the samples being grouped into experimental (E) and control (C) groups respectively. A Pre-Test and Post-Test were administered to the groups and the result was analysed using a t-test. The analysis revealed that the experimental group has a mean score that is significantly higher than that of the control group. It was then concluded from the findings that the cooperative approach of teaching and learning employed during the intervention processes improved the students' academic achievements. The cooperative approach promoted students' participation in the learning process and it must be encouraged by all.

Keywords: Cooperative Learning, word problems, algebraic linear equations, mathematics education, problem-solving.

1.0 INTRODUCTION

Mathematics is life and we do mathematics in one way or the other in our daily activities. The knowledge of mathematics is required now than ever especially with the current issue of science and technological advancement and attainment of the Sustainable Development Goals 4 (MDGs). Mathematics occupies a central place in our school curriculum as it is made a compulsory subject for all learners at the pre-tertiary level. According to Azuka (2000), Mathematics permeates the whole society and its use seems to assume ever-increasing importance as our society become more technological. Therefore, complex Mathematics skills and thinking are not the prerogative of scientists, engineers and technologist only, but they are used in everyday decision-making by people. T

he building of a nation technologically is the sole responsibility of all her citizens irrespective of gender, class, status and religion (Kojiggiji, 2008). Bello (2006) was of the view that, science in general and Mathematics, in particular, has long been criticized by students and teachers alike to be full of abstract ideas. It is a subject dreaded by several students in all tiers of education (Bello, 2006). Over the years, efforts have been made by Mathematics educators towards improving the teaching and learning of Mathematics in Ghanaian schools.

Despite these diverse efforts, Mathematics education in Ghana is still in a deplorable state at all levels of Ghanaian education system. Fasasi (2009), made effort to find solution to the ugly situation of poor performance in Mathematics and identified teaching techniques of the teachers as one of the contributory factors. This may be because effective teaching makes learning more quantitative and qualitative. Fasasi (2009) revealed that instructional approaches adopted by the teacher affects the cognitive, affective and psychomotor outcomes of the learner.

Why do most students take Mathematics subject up to the tertiary level and yet a greater percentage perform abysmally? Why do both teachers and learners perform poorly in the teaching and learning of Mathematics? How do the present tradition of teaching far from being satisfactory? Is the teaching approach of teachers a contributory factor to the poor performance of students in Mathematics? The answers to these questions may be found in the impediments which hamper students from a successful learning of Mathematics at the tertiary level.

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1.1 Statement of the Problem

The authors believe that learners can develop firm conceptual basis of translating word problems into Mathematical statements if they are provided with framework, where they can easily make reference, hence my adoption and use of cooperative learning. Moreover, effective use of cooperative learning would promote students' confidence and effective students' Mathematical contributions in the classroom.

1.2 Theoretical Framework

Cooperative Learning according to Springer, Stanne and Donovan (2006) is a generic term that is used to describe an instructional arrangement for teaching academic and collaborative skills to small heterogeneous groups of students. The authors further explained that the term cooperative learning refers to students working in teams on an assignment or project under conditions in which certain criteria are satisfied, including team members being held individually accountable for the content of the completed assignment or project.

Therefore, it can be said that cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. Cooperative efforts result in participants striving for mutual benefit so that all group members gain from each other's efforts, recognizing that all group members share a common fate. The challenge in education today is to effectively teach students of diverse ability and differing rates of learning.

In Ghana teachers are expected to teach in a way that enables pupils/students to learn mathematics concepts while acquiring process skills, positive attitudes and values and problem' solving kills. A variety of teaching strategies have been advocated for use in Mathematics classroom, ranging from teacher-cantered approach to more students-cantered ones. Several studies have been done by researchers on cooperative learning in Science and Mathematics (Redish (2000); Gillies (2002); Abrami, Poulsen and Chambers (2004); Johnson and Johnson (2005), etc.). However, cooperative learning is grounded in the belief that learning is most effective when students are actively involved in sharing ideas and working cooperatively to complete academic tasks.

2.0 METHODOLOGY

2.1 Research Design

According to De Vos (2002), a research design is a plan, recipe or blueprint for the investigation and thus offers a clear description of how the research is going to be conducted. The research design model for this research study is action research and it seeks to address the different research questions in the study. The study employed parallel group design under the quasi–experimental research design which consists of two groups; the control group and the experimental group. The cooperative learning approach used to teach the experimental group while the control group was taught with the conventional lesson method.

2.2 Population and Sampling

The targeted population of this research study consist of level 100 students of Akrokerri College of Education offering Bachelor of Basic Education programme. In all, forty–two (42) students made of twenty-four (24) males and eighteen (18) females selected purposely for this study. Out of this, twenty-seven (27) of them served as the experimental group and the remaining fifteen (15) students formed the control group. The experimental group had eleven (11) females and sixteen (16) males representing 40.74% and 59.26% respectively. In the control group, eight (8) out of the fifteen are males representing 53.33% are boys and the remaining seven (7) representing 46.67% are females.

2.3 Instrumentation

The main research instruments used in conducting this research study were the pre–test and post–test methods. The instruments were well designed for easy collection, interpretation, analysis and organisation of the data collected. The pre–test and the post–tests task were given to students to carry out in order to know their level of performance and were administered to both the control group and experimental groups.

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3.0 RESULTS AND FINDINGS

The results of the study obtained by the students were analysed and discussed in relation to the objectives of this research study. The analysis of the data was divided into two parts. The first part dealt with the Descriptive analysis and the second part also looked at the inferential analysis of the data. Statistical Package for Social Scientist (SPSS) was used for the inferential analysis of the study.

3.1 Pre-Test Scores

The pre-test was conducted based on the students' previous knowledge on the Mathematical concepts they have learnt. The students were asked to freely choose any method of their choice to solve the questions. The pre-test consisted of ten (10) questions which were marked out of fifty (50) and was conducted for forty-two (42) students. Tables 1 and 2 shows the frequencies of the respective scores for the Experimental and Control groups.

Table 1: *Frequency distribution of Pre – test Scores in Percentage by students in the experimental group.*

SCORES	FREQUENCY	PERCENTAGE (%)
1—10	5	18.52
11—20	13	48.15
21—30	8	29.63
31—40	1	3.70
TOTAL	27	100.00

Table 2: *Frequency distribution of Pre – test Scores in Percentage by students in the control group*

SCORES	FREQUENCY	PERCENTAGE (%)
1—10	1	6.67
11—20	8	53.33
21—30	5	33.33
31—40	1	6.67
TOTAL	15	100.00

Table 3: *Descriptive Statistics of Pre-Test Scores for Both Experimental and Control Group.*

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Pre-test marks	Experimental group	27	16.78	7.250	1.395
	Control Group	15	19.87	5.553	1.434

To address these challenges of the students, a series of intervention activities using the cooperative teaching and learning approach were organised by the authors for the students in the experimental group and used the conventional teaching method for the students in the control group. A post – test was administered to them to both groups and this was aimed at ascertaining whether the intervention had gone down well with them.

3.2 Post-Test Score

The post – test on the other hand was conducted to see how the intervention activities helped the students to improving their performance in modelling algebraic word problems into algebraic linear equations using the cooperative teaching and learning approach. Tables 4 and Tables 5 shows the frequencies of the respective scores for the Experimental and Control groups.

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Table 4: *Frequency distribution of Post – test Scores in Percentage by students in the experimental group*.

SCORES	FREQUENCY	PERCENTAGE (%)
1—10	2	7.41
11—20	4	14.81
21—30	5	18.52
31—40	3	11.11
41—50	13	48.15
TOTAL	27	100.00

Table 5: *Frequency distribution of Pre – test Scores in Percentage by students in the control group.*

SCORES	FREQUENCY	PERCENTAGE (%)
11—20	5	33.33
21—30	8	53.33
31—40	2	13.33
TOTAL	15	100

4.0 DISCUSSION AND CONCLUSION

4.1 Discussion

Table 6 below indicates the mean, standard deviation and standard error mean of the paired samples.

Table 6: *Paired Samples Statistics of Pre-Test and Post Test Scores for both the Experimental and the Control Group*.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST FOR EXPERIMENTAL GROUP	16.78	27	7.250	1.395
	POST TEST FOR EXPERIMENTAL GROUP	34.07	27	13.997	2.694
Pair 2	PRE TEST FOR CONTROL GROUP	19.87	15	5.553	1.434
	POST TEST FOR CONTROL GROUP	24.00	15	5.155	1.331

Analysing the results above, the mean score of the pre-test and the post-test for the experimental group were 16.78 and 34.07 respectively, with a mean difference of 17.29. The standard deviation of the pre-test scores for the same experimental group was also 7.250 whiles that of the post – test was 13.997. With this, a conclusion can be drawn from the mean scores of both the pre – test scores and the post – test scores of the experimental group that comparatively, the means scores showed a significant improvement in students' performance in solving algebraic word problems.

The mean score of the pre – test scores and the post – test scores for the control group were 19.87 and 24.00 respectively. Showing a mean difference of 4.13. The standard deviation of the pre – test scores for the control group was also 5.553 whiles that of the post-test was 5.155. This indicates that, there were changes as a result of the intervention but the changes were very small as compared to that of the experimental group.

4.2 Conclusion

Mathematics has been an intimidating subject for many people, particularly in the area of algebraic word problems. The main intervention for this study was the cooperative approach of teaching and learning. The statistical analysis showed that the intervention activities helped improve students' competence in solving algebraic word problems. The performance of the students in solving algebraic linear expressions, modelled out of algebraic word problems, through the use of the cooperative approach of teaching and learning as a teaching strategy by the researcher, had improved. The intervention also led to the students developing a more positive attitude towards mathematics in general.

Competing Interest

Authors have declared that no competing interests exist.

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