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# Effect of Cooperative Learning on Students' Attitude and Performance towards Probability Distributions in Statistics

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**Abstract**
The study was designed to determine the effect of cooperative learning on students' attitude and performance towards probability distributions in statistics. The design for the study was quasi-experimental control group pre-test and post-test design. Sample for the study consisted of 60 second year students at Mukuba University who were not repeating statistics. Data for the study was collected through two researcher developed instruments: Probability Distributions Performance Test (PDPT) and Probability Distribution Attitude Questionnaire (PDAQ). The 60 students were divided into two classes of 30 students each and were assigned to experimental group and control group respectively. The experimental group was taught using cooperative learning approach while the control group was taught using conventional learning approach. Data for the study was analysed using mean, standard deviation and independent t-test statistics. The null hypothesis was tested at 5% significance level. The findings of the study revealed that cooperative learning improved students' academic performance in Probability Distributions in Statistics. Furthermore, the findings of the study revealed that cooperative learning approach increased student's positive attitude towards statistics in the experimental group as compared to the control group. Therefore, incorporating cooperative learning approach in teaching statistics was found to have a positive effect on enhancing students' performance and attitude towards statistics.
**Keywords:** Cooperative Learning Approach, Conventional Learning Approach, Attitude, Performance

## 1.0 Introduction

The construction of new schools and upgrading of basic schools into secondary schools in Zambia called for training of more teachers for Home Economics, Science and Mathematics. Among the measures the government of Zambia took was the upgrading of Copperbelt Secondary Teachers College (COSETCO) in Kitwe into a university in 2012 (The Post 04 November 2012 Issue No: 246). As a university, the teachers training institution which now offers a four-year Bachelor of Education Degree programme on full time and distance learning, was opened in 1972 as Copperbelt Secondary Teachers College to train secondary school teachers. Mukuba University, formerly (COSETCO) has been producing teachers for Science, Home Economics and Mathematics from 1972. Before 1972, COSETCO was a catholic run secondary school called St Francis Secondary School under the Franciscan Missionaries. In 1972, government transformed St Francis Secondary School into COSECTO (Kelly 1999). The aim of transforming St Francis Secondary School into COSECTO was to supply well qualified secondary school diploma teachers for Home Economics, Science and Mathematics in Zambia.

The motivation for this study stems from the researchers' observation that Introduction to Probability and Statistics (MAT 250) has been and is still posing a number of challenges to the students who are majoring Mathematics in second year. For instance, out of 94 candidates who sat for MAT 250 examination in the 2014 academic year, only 48 candidates representing 51% passed the course while 46 (49%) failed the course. Out of 79 candidates who sat for MAT 250 examination in the 2015 academic year only 42 candidates, representing 53% passed the course while 37 (47%) failed the course. The 2016 academic year results shows that fifty five (55) students sat for statistic examination. Thirty four (34) students passed and this represents 62% and 38% failed the course. The course has nine (9) sub topics and one of the topics is Random Variables and Probability Distributions.

## 2.0 Methodology

### 2.1 Research Design

Research design is the conceptual structure within which the research is conducted (Kothari, 2004). It constitutes the blueprint for the collection, measurement and analysis of data. As such the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data. In short, research design can be defined as a plan, structure and strategy of a research to find out alternative tools to solve the problem and to minimise the variances. The study used mix methods approach in order to observe the effects of Cooperative Learning. According to Creswell (2014), mixed research approach involves the collection of both qualitative (open-ended) and quantitative (closed-ended) data in response to the research question or hypothesis. In this study, qualitative data was gathered from observations of Probability

Distribution lessons whereas quantitative data was gathered from Probability Distributions pre-test and post-test results. Finding out about the effect of cooperative learning approach on students' performance and attitude towards statistics was done quantitatively using Probability Distributions Performance Test (PDPT) and Probability Distribution Attitude Questionnaire (PDAQ).

The study used a quasi-experimental research design. It was quasi-experimental because participants were chosen through purposive sampling methods, rather than a true randomized sample (Kothari, 2004). The research, however, was experimental because its goal was to determine the effect of the independent variable on the dependent variable under study. In this regard, the Cooperative Learning strategy was the independent variable, while student's performance attitude towards Probability Distributions were considered as the dependent variable. Quasi experimental design was used to determine the effects of cooperative learning on students' performance in Probability Distributions. This was Pre-test Post-test control group. Questions in the pre-test and post-test were based on Binomial and Poisson Distributions. The experimental group studied Binomial and Poisson Distributions using cooperative learning method of teaching while the control group studied Binomial and Poisson Distributions using conventional learning method of teaching. The following structure shows the experimental design that was employed in the study.

$\boldsymbol{O_1}$ **X** $\boldsymbol{O_2}$
$\boldsymbol{O_1}$ $-$ $\boldsymbol{O_2}$

Where;

- $\boldsymbol{O_1}$ Were the observations made during the pre-test measures. Both the experimental and control group were given Probability Distributions Performance Test (PDPT) and Probability Distribution Attitude Questionnaire (PDAQ).
- **X** was the treatment employed in order to assess the effect on students' performance in Probability Distributions and attitude towards Probability Distributions. The experimental group was taught using cooperative learning approach while the control group was taught using conventional learning approach.
- $\boldsymbol{O_2}$ Were the observations made during the post-test. Both the experimental and the control groups were given Probability Distributions Performance Test and then Mathematics Attitude Questionnaire as post-test measures. Then comparisons were made between pre-test and post-test attitude and performance within groups and between groups. The significant difference in performance in Probability Distributions between the two groups were as the result of treatment (cooperative learning).

### 2.2 Target Population

Target population is the set of units to be studied (John and Sons, 2004). The population of this study included all the students who were studying statistics in second year in the 2017 academic year at Mukuba University. Mukuba University had a population of eighty two (82) students who were studying (MAT 250).

### 2.3 Sampling and Sampling Procedures

There was only one class for second year Mathematics at Mukuba University who were studying MAT 250 in the 2017 academic year. Data was collected using Probability Distributions Performance Test (PDPT) and Probability Distribution Attitude Questionnaire (PDAQ). Pre-test and Post-test questions were given to both groups. The sample for the study comprised 60 second year students who were not repeating statistics. Twenty two (22) students who were repeating the course were not included in the study. Therefore, the class was purposively selected to be the research subject. Random assignment was conducted to come up with two groups. One group was the experimental group and the other group was the control group. Experimental group was taught using Cooperative Learning approach while the control group was taught using conventional learning approach. In the experimental group, students were divided into groups of six members. The experimental group consisted of 30 students while the control group consisted of 30 students who were taught using the conventional learning method.

### 2.4 Data Collection Instrument/Techniques/Methods

The two dependent variables in the study were: Attitude towards statistics and performance in Probability Distributions. To assess performance of students in Probability Distributions, test questions were prepared by the researcher. In order to ensure that the instrument was valid, two experts in statistics at Mukuba University validated it. Test questions were used for pre-test and post-test. The second dependent variable that is attitude towards statistics was assessed using Probability Distribution Attitude Questionnaire (PDAQ).

### 2.5 Reliability of Data Collection Instrument

Reliability demonstrates that the operation of a study, such as the data collection procedures, can be repeated with the same outcome (Kothari, 2004)). Probability Distributions Performance Test (PDPT) was developed by the researcher and it was validated by two mathematics experts. The second dependent variable that is attitude

 

towards statistics was assessed using Probability Distribution Attitude Questionnaire (PDAQ). Since the questionnaires were for attitude items, respondents were required to rate statements dealing with selected aspects of probability distributions on a five-point Likert type scale. The questionnaire consisted of 18 items. Questionnaires were pre-tested through a pilot study to ascertain their reliability in soliciting information regarding the attitude of students towards Probability Distributions in statistics at Mukuba University. The research instruments were administered to 16 respondents made up of 14 male and 2 female students. After a period of three weeks the same questionnaires were administered to the same students.

**Table 2.1: Scored items**

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X | 77 | 80 | 69 | 80 | 50 | 75 | 76 | 74 | 73 | 63 | 70 | 68 | 77 | 72 | 75 | 82 |
| Y | 82 | 72 | 72 | 73 | 52 | 62 | 71 | 73 | 68 | 67 | 66 | 68 | 70 | 65 | 76 | 76 |

The following Pearson product moment correlation (r) coefficient formula was used to compute the correlation coefficient between the two scores.

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2\,[\;N\sum Y^2 - (\sum Y)^2]}}$$

The completed questionnaires were scored and analysed using Pearson product moment correlation (r) coefficient. After the calculations the Pearson product moment correlation (r) coefficient $r = 0.757831762$ was obtained. According to Orodho (2005), a coefficient correlation (r) of about 0.75 and above should be considered high enough to judge an instrument as reliable. The researchers' value was $0.76$ and the instruments were adopted for data collection relating to the attitude of students towards probability distributions.

## 3.0 Results of the Study

### 3.1 The Pre-Test and Post-Test

The study investigated the effect of Cooperative Learning namely the Jigsaw Technique on Mukuba University students' attitudes and performance in statistics with special focus on Binomial and Poisson Distributions. At the beginning of the study, both the experimental and control group were pretested with questions in statistics involving Chi square test of goodness of fit and mean and variance of grouped data. This was done to establish whether there was a significant difference in academic ability existing between the groups before the start of the study. In order to determine the effect of cooperative learning method and conventional learning method had on the performance of the students, both the experimental and control groups were tested (Post-test) using Probability Distributions Performance Test and Probability Distributions Attitude Questionnaires

### 3.2 Test for Normality

In order to test for normality, we need to calculate the probability that the sample was drawn from a normal population. According to Pallant (2007), one of the methods used to test if the scores are normally distributed is Kolmogorov-Smirnov test.

**Figure 3.1: Histogram**

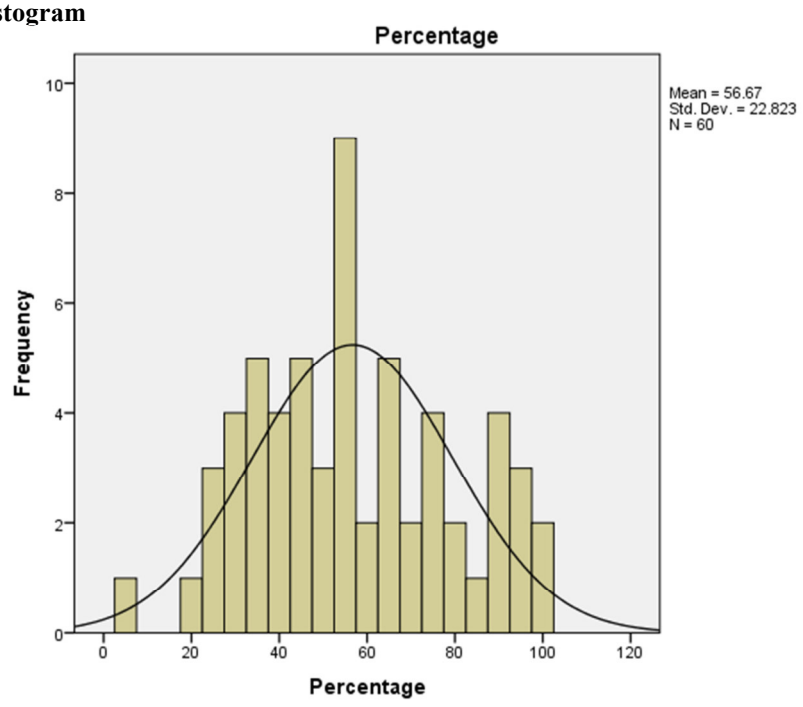

 

**Table 3.1: Test of Normality**

| | Kolmogorov-Smirnov | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | Df | Sig. | Statistic | Df | Sig. |
| Percentage | .112 | 60 | .057 | .970 | 60 | 0.151 |

From the graph in Figure 3.1 and Table 3.1 above, the scores shows that the two groups were normally distributed. From Table 3.1 above, we fail to reject $H_0$ since the P-value $= 0.057 > 0.05$ and we can conclude that the sample data is normally distributed. Since the data for the two groups was normally distributed, an independent samples t-test was used to analyse the data.

**Table 3.2: Analysis of the pre-test scores**

| | Levene's Test | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | T | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Lower | 95% Confidence Upper |
| Equal variances assumed | .013 | 0.909 | -.029 | 58 | .977 | -.167 | 5.821 | -11.819 | 11.486 |

From Table 3.2, using t-test for equality of means, we fail to reject $H_0$ since the P-value $= 0.977 > 0.05$ and we can conclude that the mean for the experimental group and the mean for the control group were the same. This suggested that both the experimental and control groups were matched in terms of academic ability at the beginning of the study.

**Research Question One: What is the effect of Cooperative Learning on students' performance in Probability Distributions?**

**Table 3.3: Analysis of the Post-Test scores using Independent Sample T-Test**

| | Group | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Results | Experimental | 30 | 55.03 | 20.073 | 3.665 |
| | Control | 30 | 32.93 | 19.16 | 3.498 |

In the Group Statistics box above in Table 3.3, the mean for the control group was 32.93 while the mean for the experimental group was 55.03. The experimental group performance mean (55.03) and the control group performance mean (32.93) indicated that the performance of the two groups was not equal.

**Table 3.4: Analysis of the Post-Test scores using Independent Sample T-Test**

| | Levene's Test | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | T | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Lower | 95% Confidence Upper |
| Equal variances assumed | 0.314 | 0.577 | 4.362 | 58 | 0.000 | 22.1 | 5.066 | 11.959 | 32.241 |

Using the independent sample t-test for equality of means, we reject $H_0$ since the P-value $= 0.000 < 0.05$ and conclude that there was a statistically significant difference in performance in Probability Distribution in statistics between students who were taught using Cooperative Learning approach and conventional learning approach**.** This means that there was a significant difference between the mean scores of the control group (mean of 32.93) and experimental group (mean of 55.03). These results suggested that cooperative learning has the capacity to improve students' academic performance

**Research Question Two**

**Is there any difference in attitude towards statistics for students who are taught using cooperative approach and those who are taught using conventional learning approach?**

To answer this question, the attitude questionnaire responses were analysed and transformed into percentage scores. The transformed total attitude scores for each respondent were used to conduct an independent samples t-test in order to ascertain the equivalence between the control group and experimental group. A questionnaire with attitude test scores is shown in Table 3.5 and Table 3.6 below.

 

**Table 3.5: Experimental Group Responses (N=30)**

| **Students' feelings** | Responses **(%)** | | | | |
|---|---|---|---|---|---|
| | Strongly Agree | Agree | Undecided | Disagree | Strongly Disagree |
| Probability distributions are interesting | 60.0 | 30.0 | 0.0 | 3.3 | 6.7 |
| I cannot spend money to buy books /materials on probability distributions because I don't enjoy it. | 3.3 | 6.7 | 10.0 | 40.0 | 40.0 |
| Probability distributions are not relevant in today's world | 10.0 | 0.0 | 10.0 | 33.3 | 46.7 |
| Probability distributions are challenging | 6.7 | 33.3 | 10.0 | 40.0 | 10.0 |
| I can encourage my friend to study probability distributions. | 36.7 | 43.3 | 3.3 | 13.3 | 3.4 |
| I cannot spend my leisure time studying probability distributions because I cannot improve. | 6.7 | 0.0 | 3.3 | 40.0 | 50.0 |
| It can be a good idea for government to spend resources in the teaching of probability distributions. | 46.7 | 40.0 | 0.0 | 3.3 | 10.0 |
| I cannot encourage my friend to study probability distributions because they are challenging | 3.3 | 3.3 | 3.4 | 50.0 | 40.0 |
| Probability distributions are useful in other courses. | 33.3 | 50.0 | 10.0 | 6.7 | 0.0 |
| It cannot be a good idea for government to spend resources in the teaching of probability distributions. | 6.7 | 0.0 | 0.0 | 53.3 | 40.0 |
| I can spend my leisure time studying probability distributions so that I can improve | 50.0 | 40.0 | 3.3 | 0.0 | 6.7 |
| Probability distributions are not useful in other courses. | 6.7 | 3.3 | 13.3 | 33.3 | 43.4 |
| Probability distributions are relevant in today's world | 40.0 | 43.4 | 13.3 | 3.3 | 0.0 |
| I cannot do any job that involves probability distributions. | 3.3 | 3.3 | 10.0 | 40.0 | 43.4 |
| Probability distributions are clear. | 23.3 | 40.0 | 16.7 | 13.3 | 6.7 |
| I can spend money to buy books/materials on probability distributions so that I can know the topic better | 46.7 | 46.7 | 0.0 | 0.0 | 6.6 |
| I can do any job that involves probability distributions. | 46.6 | 36.7 | 10.0 | 0.0 | 6.7 |
| Probability distributions are not clear. | 3.3 | 13.3 | 6.7 | 53.3 | 23.3 |

**Average percentage for positive attitude = 82%**
**Average percentage for negative attitude =11%**
**Average percentage for Undecided = 7%**

 

**Table 3.6: Control Group Responses (N = 30)**

| **Students' feelings** | Responses **(%)** | | | | |
|---|---|---|---|---|---|
| | Strongly Agree | Agree | Undecided | Disagree | Strongly Disagree |
| Probability distributions are interesting | 6.7 | 40 | 0.0 | 3.3 | 50 |
| I cannot spend money to buy books /materials on probability distributions because I don't enjoy it. | 20 | 56.7 | 13.3 | 6.7 | 3.3 |
| Probability distributions are not relevant in today's world | 46.7 | 36.7 | 10 | 3.3 | 3.3 |
| Probability distributions are challenging | 33.3 | 30 | 6.7 | 13.3 | 16.7 |
| I can encourage my friend to study probability distributions. | 30 | 6.7 | 0.0 | 60 | 3.3 |
| I cannot spend my leisure time studying probability distributions because I cannot improve. | 33.3 | 60 | 3.3 | 0.0 | 3.3 |
| It can be a good idea for government to spend resources in the teaching of probability distributions. | 33.3 | 13.3 | 3.3 | 3.3 | 46.7 |
| I cannot encourage my friend to study probability distributions because they are challenging | 30 | 63.3 | 0.0 | 6.7 | 0.0 |
| Probability distributions are useful in other courses. | 33.3 | 6.7 | 10 | 6.7 | 43.3 |
| It cannot be a good idea for government to spend resources in the teaching of probability distributions. | 36.7 | 46.7 | 0.0 | 13.3 | 3.3 |
| I can spend my leisure time studying probability distributions so that I can improve | 26.7 | 6.7 | 16.7 | 33.3 | 16.7 |
| Probability distributions are not useful in other courses. | 30 | 40 | 10 | 10 | 10 |
| Probability distributions are relevant in today's world | 26.7 | 10 | 10 | 6.7 | 46.7 |
| I cannot do any job that involves probability distributions. | 30 | 30 | 13.3 | 10 | 16.7 |
| Probability distributions are clear. | 13.3 | 33.3 | 16.7 | 16.7 | 20 |
| I can spend money to buy books/materials on probability distributions so that I can know the topic better | 26.7 | 3.3 | 0.0 | 6.7 | 63.3 |
| I can do any job that involves probability distributions. | 26.7 | 10 | 16.7 | 40 | 6.7 |
| Probability distributions are not clear. | 20 | 36.7 | 6.7 | 26.7 | 10 |

**Average percentage for positive attitude = 28.3%**
**Average percentage for negative attitude = 63.2%**
**Average percentage for Undecided = 8%**

From Table 3.5 above, students in the experimental group had positive attitudes towards probability distributions in statistics. The average percentage for positive attitude was 82%. This means that 82% of the respondents in the experimental group had positive attitude towards probability distributions in statistics. Eleven percent of the respondents in the experimental group had negative attitude towards probability distributions while 7% were undecided. From Table 3.6 above, students in the control group had negative attitude towards probability distributions in statistics. The average percentage for positive attitude was 28.3%. This means that 28.3% of the respondents in the control group had positive attitude towards probability distributions in statistics. Meanwhile, 63.2% of the respondents in the control group had negative attitude towards probability distributions

 

and 8% were undecided.

The attitude scores for both the experimental group and control group were analysed using the independent t-test.

**Table 3.7: Group Statistics**

| Group | | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Attitude | Experimental | 30 | 73.67 | 12.09 | 2.207 |
| | Control | 30 | 63.07 | 6.777 | 1.237 |

The experimental group performed significantly better in the post-test with the mean of 73.67 than the control group with mean of 63.07.

**Table 3.8: Independent Samples Test**

| | | Levene's Test | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | T | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Lower | 95% Confidence Upper |
| Attitude | Equal variances assumed | 3.6781 | .06 | 4.189 | 58 | .000 | 10.6 | 2.53 | 5.535 | 15.665 |

Since the research involved to compare the attitude for the experimental group and the control group towards statistics, an independent samples t-test was used. Using the P-value approach on Table 3.8 above, we reject $H_0$ since the P-value $= 0.000 < 0.05$ and conclude that there is a statistically significant difference in attitudes towards statistics for students who were taught using cooperative learning approach and those who were taught using conventional learning approach. This means that the experimental group had far better positive attitude towards statistics than the control group. The results of the study indicated that the cooperative learning approach increased student's attitude towards statistics in the experimental group as compared to the control group.

## 4.0 Discussion of Findings

### 4.1 Effects of Cooperative Learning on Students' Performance in Probability Distributions

The analysis conducted shows that students who were taught using cooperative learning strategy performed better than those who were taught using conventional learning approach. These results are in line with Martin and Roland (2007) who concluded that students with low academic self-concept profited more from cooperative instruction than from direct instruction because they experience a feeling of greater competence.

### 4.2 Effect of Cooperative Learning on Students' Attitude towards Statistics

In this study, it has been found that incorporating cooperative learning approach in teaching statistics does have an effect on students' attitude towards statistics. The results suggest that when cooperative learning approach is incorporated in statistics lessons, students' attitude towards statistics is enhanced significantly and it generally becomes positive. These results are consistent with student responses to cooperative learning reported by other researchers (Abdullah, 2010: Hua 2014).

### 4.3 Conclusion

Results showed that students in the experimental group had positive attitudes towards probability distributions compared to those students who were taught using conventional learning approach. Furthermore, there was a statistical difference in performance between the experimental group taught probability distributions using cooperative method and that of the control group taught using conventional method. Therefore, the study found that the cooperative learning approach has a positive effect on the students' performance and attitude towards probability distributions in statistics as compared to the conventional learning method. These results would imply that incorporating cooperative learning in the mathematics classroom would enhance the learning of mathematics at Mukuba University.

### 4.4 Recommendations

Based on the findings of the study, the following recommendations were made;

- Cooperative learning to be 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.

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